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Evaluation of best price clauses in hotel booking

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Evaluation of Best Price Clauses in Online Hotel Booking

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Ulrich Laitenberger[‡] and Frank Schlütter[§]

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Abstract

We analyze the best price clauses (BPCs) of online travel agents (OTAs) using meta-search price data of nearly 30,000 hotels in different countries. We find that BPCs influence the pricing and availability of hotel rooms across online sales channels. In particular, hotels publish their offers more often at Booking.com when it does not use the narrow BPC, and also tend to promote the direct online channel more actively. Moreover, the abolition of Booking.com's narrow BPC is associated with the direct channel of chain hotels having the strictly lowest price more often.

Keywords: Best price clauses, hotel booking, MFN, OTA, vertical restraints.

JEL Class: D40, L42, L81

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1 Introduction

Motivated by recent proceedings against best price clauses (BPCs) imposed by online travel agents (OTAs), we empirically investigate the effects of such clauses using meta-search price data of nearly 30,000 hotels in various countries.¹ Under a BPC, an OTA obliges the hotel not to offer better prices or conditions on other distribution channels than on the OTA. Various national competition authorities in Europe agreed that best price clauses could restrict competition between OTAs for commission rates, but eventually arrived at different assessments and decisions.² These differences trigger the question how BPCs actually affect the market outcome. The theoretical literature on this topic is developing rapidly and shows that BPCs can harm consumers (Boik and Corts, 2016; Edelman and Wright, 2015; Johnson, 2017; Wang and Wright, 2017), but can also be welfare enhancing (see in particular Johansen and Vergé, 2017). However, empirical research on this topic is yet very limited. With this article we start to fill the gap.

We exploit the variation in the BPCs due to different enforcement policies across various countries and over time. The different national decisions seem to be due to differences in the assessments rather than to fundamental differences in the market characteristics in each country (see Hunold, 2016). For instance, the French competition authority had accepted Booking.com’s commitments to narrow down the parity clauses in April 2015, just to be overruled by the French parliament that completely prohibited BPCs of OTAs in July 2015. These different decisions provide a quasi-experimental setup for assessing the effects of different BPC policies.

Our focus is on analyzing how the abolition of a BPC has influenced on which distribution channels hotels publish prices (OTAs and their direct channel) and the pricing of the same hotel room across these channels. A BPC can restrict price differentiation as it forbids hotels to charge higher room prices at the OTA imposing the clause than on other channels covered by the clause (narrow BPCs cover only the direct channel, wide BPCs also other OTAs)³. There are related clauses, such as availability requirements, which

¹In this article, we generally refer to hotels as the typical accommodations on offer at a booking platform. In its general terms and conditions, Booking.com uses the term “accommodation”. Other types of accommodation present on OTAs include, for example, holiday apartments.

²See Annex IV for a list of the different decisions.

³Under a *wide* BPC, an OTA obliges the hotel not to charge a higher price on the OTA than on almost any other booking channel, which in particular includes other OTAs and the hotel’s own direct

further restrict a hotel’s sales strategy. If a hotel faces less parity restrictions, it might thus price differentiate more across channels. In particular, a hotel could lower the prices on its direct channel, where the marginal distribution costs are potentially lowest. A hotel might also start using an OTA that has relaxed its parity clauses, and could start using other channels which had been less attractive to use in view of these restrictions.

The main data source are price data from the website Kayak that covers the period January 2016 to January 2017. Kayak is a travel meta-search engine that displays the prices of the same hotel room on different online distribution channels, in particular the OTAs and the hotel website to which we refer as *direct online channel*. We complement this data set with data from two additional sources. First, we add data from the OTA website Booking.com, which allows us to distinguish between chain and independent hotels. Second, we gathered time series data of travel related search queries from Google Trends. These data date back before the beginning of our observation period and allow us to control for other than BPC-related developments in the analyses.

Our empirical approach is twofold: In view of different BPC policies across countries, we use cross-sectional statistics to investigate the channel choice and pricing across channels. Moreover, we analyze the removal of Booking.com’s narrow BPC in Germany since February 2016.⁴ By means of regression analyses, we compare the changes in the market outcome in Germany with the changes in other countries without such a regulatory treatment of the BPCs in the course of 2016.

We find that the price of the direct channel among hotel chains is more often strictly lower than the prices on all other visible online sales channels following the abolition of Booking.com’s narrow BPC in Germany. At the same time, the price at Booking.com is less often the lowest among hotel chains in Germany. This suggests that Booking.com’s BPC did restrict the hotels’ price setting. The result is consistent with a simple cost based pricing in case that the hotel has lower distribution costs on the direct online channel relative to the OTAs that typically charge commission rates for each mediated booking. The result is also consistent with free-riding in the sense that hotels might use

sales channels. *Narrow* BPCs prohibit the hotel from publishing lower prices on its direct online sales channels than at the OTA that imposes the clause. A narrow BPC does *not* contractually restrict the hotel’s room prices at other OTAs.

⁴We also partly capture a legislative prohibition of BPCs in Austria.

the OTAs to show their rooms, but induce customers with lower prices to eventually book directly.

With respect to the availability of hotel room offers on different distribution channels, we find that more hotels start using Booking.com as a distribution channel following the abolition of Booking.com’s price parity and minimum availability clauses in Germany – also relative to the developments in unaffected countries. This result suggests that a fraction of the hotels indeed responds to parity clauses by not being active at an OTA imposing them. Similarly, hotels that had already been active on Booking.com before increasingly often publish prices there. Moreover, we observe a distinctive increase in the availability of the direct online channel of chain hotels at Kayak in Germany, also relative to other countries. This indicates that these hotels increasingly promote the direct channel when they are not constrained by Booking.com’s narrow BPC.

In France and Austria, we partly observe similar developments as in Germany. In particular, we observe that in these countries more hotels have started using Booking.com as a distribution channel. In Austria, hotels which had already been active at Booking.com more often publish prices at this OTA. These patterns support the results we have found in Germany as they can be related to changes in the BPCs in these countries. The Austrian parliament passed a law in November 2016 that prohibits BPCs of OTAs from January 2017 onward, following an intensive public debate and consultation process in 2016. In France, all BPCs of OTAs had been prohibited in August 2015 with the *Loi Macron*, and in November 2016 the commercial court in Paris also prohibited the OTAs to use availability parity clauses.⁵

The remainder of the article is structured as follows. We discuss the related literature in the next section, introduce the data and present descriptive statistics in Section 3, discuss conjectures, methodology and identification in Section 4, show the analysis of the pricing in Section 5 as well as price publications across channels in Section 6, present various robustness checks in Section 7 and conclude in Section 8.

⁵See Annex 8 for details and references of the various decisions with respect to BPCs of OTAs in Europe.

2 Related literature

Theory in relation to BPCs

Recent theoretical research investigates the theory of harm of various competition authorities that BPCs could restrict competition between OTAs for commission rates. Boik and Corts (2016) analyze BPCs in a model in which customers can only purchase through a platform, and not directly from the producers. The article concludes that when sellers set the prices at which consumers buy at a sales platform (referred to as *agency model*, which is typical for hotels and OTAs), BPCs lead to higher consumer prices. The reason is that with BPCs in place the platforms have limited incentives to compete in the terms of trade they offer to the sellers. This logic also reflects the main theory of harm of the competition authorities in Europe (Hunold, 2016). Johnson (2017) and Foros et al. (2017) show that platforms have incentives to adopt the agency model instead of the merchant model. Their results also suggest that BPCs increase retail prices.

Another important feature of online hotel distribution is that hotels typically sell rooms on direct channels such as their website. Edelman and Wright (2015) and Wang and Wright (2017) directly address this by allowing customers to buy from either the platform or the direct channel. Edelman and Wright (2015) find that platforms have excessive incentives to invest in convenience benefits when there are BPCs and customers can also buy the products directly from the sellers. Wang and Wright (2017) allow customers to search on the platform and switch the sales channel to complete the transaction. They show that, absent BPCs, the possibility of consumers to buy directly at a lower price disciplines the platforms' incentives to charge high commissions, but may make platforms unviable.

In contrast to the contributions above, Johansen and Vergé (2017) offer a divergent view on the main theory of harm. They show that BPCs do not necessarily lead to higher commission rates and consumer prices if hotels can decide whether to be active on the OTA. Moreover, they conclude that narrow BPCs do not increase competition between intermediaries when compared to wide BPCs. These findings could explain the observation that commission fees of OTAs have apparently remained unchanged in Europe following the move of Booking.com in 2015 to use only narrow BPCs.⁶

⁶In 2016, a HOTREC study finds that for more than 90% of all hotels the effective commission

In summary, the theoretical literature provides arguments that BPCs might have various anti-competitive effects, but there are also counter-arguments.

Empirical literature in relation to OTAs

It remains an empirical question whether and – if yes – how the wide and narrow BPCs of OTAs affect the market outcome. To our knowledge, there are not yet any research articles available which address this question.⁷ However, there is related research which investigates online pricing and the role of online intermediaries.

In general, our article relates to studies that characterize online pricing. Cavallo (2017) as well as Gorodnichenko and Talavera (2017) report that there is considerable online price dispersion for narrowly defined product categories and changes of prices occur more frequently online than offline. Other studies that particularly address price dispersion are Ghose and Yao (2011) and Zhao et al. (2015). They find that price dispersion is prevalent in both list prices and transaction prices, but less so in the latter. We also find considerable price dispersion across distributions channels and study how this is affected by BPCs.

There are a few related papers that particularly address the role of intermediaries such as OTAs and the relationship to retailers. De los Santos and Wildenbeest (2017) investigate differences between the agency model and the merchant model in the e-book market. They find that retail prices for e-books are significantly lower when the sales platforms such as Amazon act as merchants and set the retail price. Ursu (2016) highlight the importance of OTAs for the intermediation of hotel rooms by showing that in case of Expedia a higher ranking of a hotel significantly increases the click-rate for that hotel.⁸

In a case study, Lu et al. (2015) find that the introduction of a new online direct sales

rates have not decreased over the past one year (see <http://www.hotrec.eu/newsroom/press-releases-1714/dominant-online-platforms-gaining-market-share-in-travel-trade-no-signs-of-increased-competition-between-online-travel-agents-unveils-european-hotel-distribution-study.aspx>; last accessed December 1, 2017).

⁷Various European competition authorities conducted an evaluation of BPCs in hotel booking in 2016 using meta-search data. They find that price dispersion increased across OTAs following the reduction of price parity clauses. They do not address the direct channel as we do. We provided input for this exercise in early 2016, including our research setup. See “Report on the Monitoring Exercise carried out in the Online Hotel Booking Sector by EU Competition Authorities in 2016”, available at http://ec.europa.eu/competition/ecn/hotel_monitoring_report_en.pdf (last accessed December 1, 2017).

⁸In a related vein, Ghose et al. (2012) find that a high quality ranking of hotels can save consumers up to about 9 USD per hotel booking.

channel of a hotel chain in 2002 led to a significant reduction of the prices at physical travel agents. This result suggests that there is competition between different forms of sales channels for hotel distribution. Lu et al. do not study BPCs, which is the focus of our study.

3 Data and descriptive statistics

3.1 Data sources

Prices and hotel characteristics from Kayak and Booking.com

We use data on prices of hotel rooms on different online sales channels such as Booking.com, Expedia and the hotels' direct online channel from the travel meta-search engine Kayak.⁹ We understand that Kayak derives revenues from advertising placements on its websites and mobile apps as well as from sending referrals to travel service providers, OTAs, and hotels.¹⁰ Moreover, we understand that Kayak directly receives the hotel offers from the OTAs that are available there and does not post own prices.¹¹ Hotels can submit offers of their direct online channel to Kayak, either with their own booking engine or a third-party booking engine provider.¹²

A typical search request at Kayak requires a travel destination, the travel dates, the number of travelers and the number of rooms as inputs, for instance two persons looking for one room in Rome for an overnight stay in two weeks from today. In response to a search request, Kayak displays a list of available hotels. For every hotel, Kayak lists the prices of the available sales channels.¹³ We refer to the list of all available sales channels

⁹We use the German edition of the Internet site www.kayak.de. We have done anecdotal checks and found that the offers which were available at [Kayak.de](http://www.kayak.de) were also available at Kayak websites in other languages, such as [Kayak.fr](http://www.kayak.fr). Since 2013, Kayak is a subsidiary of the Priceline Group, which previously also acquired the online travel agencies [Booking.com](http://www.booking.com) (2004) and [Agoda.com](http://www.agoda.com) (2007).

¹⁰Priceline Group Inc. Annual Report 2015 (p.2). See <http://ir.pricelinegroup.com/annuals.cfm>; last accessed December 1, 2017. Hotels report that they have to pay a monthly fee for having their direct channel listed at Kayak, and also a fee whenever a Kayak user is forwarded to the hotels' website. Source: Phone interviews that we conducted with European hoteliers in 2016.

¹¹Kayak sometimes presents a "Kayak" price. However, we found that this always corresponds to one of the other posted offers of, for instance, [Booking.com](http://www.booking.com).

¹²Booking engines such as [Fastbooking](http://www.fastbooking.com), [Travelclick](http://www.travelclick.com) or [Derbysoft](http://www.derbysoft.com) offer the services necessary to connect the hotel to Kayak.

¹³Also, Kayak sometimes includes itself in the list of hotel price offers. However, a click on the "Kayak offer" redirects to OTAs which also belong to the Priceline Group such as [Booking.com](http://www.booking.com). Therefore, whenever we observe a Kayak entry, we substitute it with the corresponding underlying Priceline OTA and eliminate potential duplicates.

for a particular hotel at a particular travel date as a *Kayak request*.

Kayak as a meta-search site redirects customers to the hotel website or the OTA websites. Bookings then take place through these distribution channels. In the case that customers choose an OTA to book a hotel room, it is important to note that the OTA typically only acts as an intermediary between the hotel and customer while the hotels generally set the prices at the OTAs. The best price clauses (if they exist) are specified in the contracts between the hotels and the online travel agents. As a consequence, changes in the BPCs, which are induced by national competition law enforcement or new laws, target the contracts between the hotels in the respective jurisdiction and the affected OTA.¹⁴ In order to study BPCs, we collect prices of hotels located in countries which differ in their BPC policies.

There are three types of countries for which we collect data:¹⁵

1. Countries without BPCs:

- (a) France (general prohibition of OTAs' BPCs by law in July 2015)

- (b) Germany (HRS prohibited in December 2013, Booking.com since February 2016; Expedia still has a narrow BPC)

- (c) Austria (narrow BPCs since July 2015, prohibition by January 2017, this had been subject to public debate already in 2016).

2. Narrow BPC countries: This includes nearly all other European Union (EU) member states as regards the major OTAs Booking.com and Expedia (see exceptions above). Our data captures mainly Italy and Sweden, as well as various cities close to the German border.

3. Wide BPC countries: Today only non-EU countries as regards at least the major OTAs Booking.com and Expedia. We have collected data for Canada.

We collect prices from Kayak for all listed hotels from a wide range of cities: the 25 biggest German cities, a list of the 15 biggest cities and 15 popular tourist destinations

¹⁴See for instance par 6.1 of the commitments given by Booking.com in April 2015 (last accessed December 1, 2017) and point 1 of page 3 in the Bundeskartellamt's decision against Booking.com (full reference is in Annex IV).

¹⁵See Annex I for a detailed overview of countries and cities covered.

for the five countries Austria, Italy, Sweden, France and Canada, as well as a selection of 20 pairs of German and non-German cities near the German border. We collect data from January 26, 2016 onward. The corresponding list of locations and starting dates for data collection can be found in Annex I. Prices are collected for overnight stays for two persons in one room on the same day and the 7th, 14th, 21th and 28th day ahead.¹⁶

For each hotel, Kayak also provides general information on room types, bed types, hotel stars and booking conditions from the different distribution channels and displays them to the customer when clicking on a particular hotel offer. We collect the data from the overview page that lists all the available hotels in the cities of interest.

In addition to the price data from various distribution channels, the Kayak data also contains hotel-specific characteristics. These include the hotel stars, and the Kayak customer rating (from 0 to 10). Moreover, we obtain information on the number of rooms or whether the hotel belongs to a chain from the respective hotel profile website on Booking.com. The chain classification (including sub chains) distinguishes 884 distinct chains in the cities that we study. All hotels not belonging to one of these chains are treated as “independent”.¹⁷

It is possible that hotel chains have different distribution and marketing strategies, benefit from economies of scale or react differently to contract changes. Moreover, hotel chains potentially have more bargaining power towards OTAs and occasionally might be able to negotiate contracts that differ from the standardized contracts between OTAs and independent hotels. In order to account for the heterogeneity between these different hotel types, we conduct the analyses separately for chain and independent hotels. We discuss the concern of potential further unobserved heterogeneity and present robustness checks in this regard in Section 7.

¹⁶On certain dates, we were able to collect prices for more travel dates than 0, 7, 14, 21 and 28 days in advance of the booking date, e.g for all days within a 30 day period between booking and travel date, but due to technical difficulties on some days we collected less data. In the analysis, only the observation with travel dates 0, 7, 14, 21 and 28 days ahead are included.

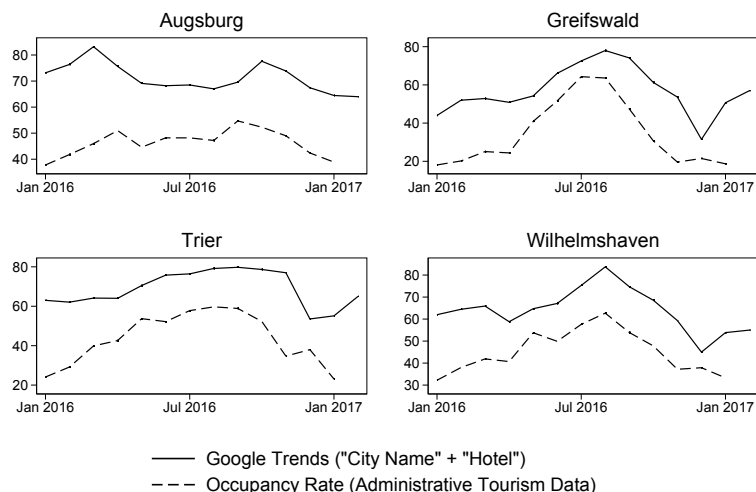
¹⁷For a small fraction of the hotels, where no profile website was available on Booking.com, we conducted analogously a manual classification into chain and independent hotels.

OTA popularity and tourism flow measures from Google Trends

We also retrieve time series data from Google Trends for the time period from January 2015 to January 2017 to approximate 1) the popularity of different OTAs among customers and 2) the tourism demand for hotels in particular cities. The data comprise the aggregated search volume of specific queries on Google over time. Similar data have already been used as a predictor of actual tourism data in other studies (Coyle and Yeung, 2016; Siliverstovs and Wochner, 2018).

For the first purpose, we collect weekly country-specific data for search queries directed to each of the OTA websites of Booking.com, Expedia and HRS.¹⁸ For the second purpose, we retrieve weekly data for the worldwide search queries consisting of the keywords “City Name + Hotel”.¹⁹ In order to validate the informative quality of the data, we gathered monthly occupancy rates for all German cities in our sample from the regional statistical offices. Accordingly, correlations with the corresponding Google Trends time series turn out to be positive and significant. As an illustration, we plot both time series in Figure 1 for four cities. For our regressions, we then disaggregate each time series inferred from Google Trends from a weekly to a daily level and merge by the search date of the Kayak request and the country or city respectively.

Figure 1: Google Trends “City Name + Hotel” and actual occupancy rates



¹⁸In the case of Expedia, Google Trends provides two options for websites to which search queries are directed, which we both use and aggregate.

¹⁹For a few cities, where the search volume for this expression was so low that Google Trends does not provide it, we collected data on the search query “City Name”.

3.2 Summary statistics of the Kayak data

In this section we present summary statistics for the main variables of our analyses and for the prevalence of the main distribution channels in the Kayak data. The observation period ranges from January 2016 until January 2017 and the data set contains data from around 30,000 hotels. Each observation in the data set refers to a hotel room at a specific travel date which is on offer at a certain search date (which we refer to as Kayak request). Every observation contains the price offers of all sales channels of the hotel as listed on Kayak. In total, the data set consists of approximately 20 million observations.

Table 1 depicts summary statistics for a set of basic variables in our data for hotel chains and independent hotels. The data are aggregated on the Kayak request level and on the hotel level. A Kayak request includes on average 5 online sales channels (OTAs and direct channel)²⁰ and in 84% of all observations we find that hotels have published prices on at least two channels.

Table 1: Basic variables by hotel type

Variable	Mean by hotel type			All observations			
	All	Chain	No chain	Std. Dev.	Min	Max	N
<i>Kayak request level</i>							
Number of listings	4.93	7.06	4.11	3.14	1	24	20,115,292
At least two listings (%)	83.67	95.72	79.02	36.96	0	100	20,115,292
Mean price in EUR	120.37	128.41	117.27	95.89	10	2,000	20,115,292
Std. Dev. price	12.66	14.80	11.65	44.73	0	4,615	16,954,059
Strict minimum price exists (%)	48.11	51.69	46.43	49.96	0	100	16,830,677
Diff. (str.) two lowest prices (%)	13.71	9.35	15.98	47.08	0	16,100	8,164,931
Avg. days before travel date	12.74	12.59	12.80	9.63	0	28	20,032,766
Share of non-listed hotels (%)	63.89	60.37	65.25	15.79	0	100	20,073,996
Kayak hotel rating	7.97	7.90	8.00	0.87	2	10	19,810,437
GT city	76.67	77.60	76.32	15.12	4	100	20,115,292
GT Booking.com	63.50	65.26	62.82	15.53	32	100	20,115,292
GT Expedia	68.02	70.72	66.97	14.82	6	100	20,115,292
GT HRS	69.57	69.79	69.49	18.28	0	100	20,115,292
<i>Hotel level</i>							
Number of rooms	52.08	123.55	31.83	74	1	1,590	27,123
Hotel chain (%)	20.50	100.00	0.00	40.37	0	100	29,497
Hotel category in stars	2.92	3.23	2.85	0.86	1	5	29,497
Kayak hotel rating	8.04	7.89	8.08	0.89	2	10	27,445
Number of ratings	628.42	1248.75	464.76	937.91	1	19515	28,564

The average price across all listings is at 120 EUR, ranging from 10 EUR to 2,000 EUR.²¹

The average standard deviation of the prices is 13 EUR for the Kayak requests with

²⁰This is consistent with Stangl et al. (2016) who find that for Germany, Austria and Switzerland hotels have published prices at 3.6 OTAs.

²¹We excluded prices below 10 EUR and above 2,000 EUR.

offers from at least two distribution channels. In 48% of all observations with at least two listings, there exists a strict minimum price.²² For the observations with a strict minimum price, the average relative difference between the lowest and second lowest price is at 14% of the lowest price. Moreover, Kayak displays for every city the number of available hotels and the total number of hotels that are generally listed at Kayak. We use the fraction of hotels that are currently not available at Kayak as one measure of hotel occupancy in a city. It has an average value of 64% across all Kayak requests. The Google Trends measures are normalized by the maximum of the search volume in the observation period and scaled to values between zero and 100.

Hotel characteristics

We report characteristics of the hotels in the sample in Table 1.²³ The average hotel has 52 rooms, 2.9 out of 5 stars²⁴ and a Kayak rating of 8 out of 10.²⁵ We identify 21% of all hotels to belong to a hotel chain. Interestingly, 28% (not reported in the table) of our Kayak requests come from chain hotels which shows that these hotels list on Kayak more often. Accordingly, we find that chain hotels on average use more distribution channels (on average 7 listings and in 96% of all cases at least two listings), are larger (124 rooms) and of higher quality (3.2 stars). Interestingly, the differences in Kayak hotel rating between chain hotels and independent hotels reveal that the customers are slightly more satisfied with independent hotels even though these hotels have fewer stars on average. Table 2 additionally compares the hotel features across distribution channels. In each column it reports the average hotel feature for the group of hotels that have used the particular distribution channel at least once. We observe that generally hotel features are comparable across distribution channels. Especially the dimensions that differ the most between hotel types exhibit less variation across distribution channels. In particular, for the independent hotels, the average number of rooms ranges between 32 and 66 rooms and the average number of ratings ranges between 474 and 857 ratings

²²Strict in the sense that the second lowest price is higher. We refer to the strictly lowest price of a response to a Kayak request also as “price leader”.

²³For these statistics each hotel has the same weight, which may not hold at the Kayak request level because the number of observations per hotel can differ.

²⁴Kayak also lists accommodations like holiday apartments without stars. We removed them from the analyses.

²⁵The information on the Kayak rating is only available for 85% of all hotels.

per hotel across the distribution channels. In contrast, chain hotels on all distribution channels are considerably larger (average number of rooms ranges between 123 and 137) and also have a higher number of ratings, which ranges on average between 1259 and 1594 across distribution channels. This finding is an indication that it is generally useful to distinguish between hotel types in order to consider more comparable hotel populations in terms of observed (and unobserved) characteristics in the analyses. We further note that when distinguishing between chain and independent hotels, the average characteristics of the respective hotels across countries are quite similar (country statistics not reported).

Table 2: Hotel characteristics by platform and hotel type

	Booking.com	Expedia	HRS	Direct
<i>Independent hotels</i>				
Number of rooms	32.10	37.23	48.17	66.33
Hotel category in stars	2.86	2.87	3.13	3.46
Kayak hotel rating	8.11	8.05	7.97	8.31
Number of ratings	474.03	599.34	749.16	856.56
<i>Chain hotels</i>				
Number of rooms	123.45	126.81	136.26	137.82
Hotel category in stars	3.24	3.28	3.44	3.30
Kayak hotel rating	7.92	7.92	8.01	7.90
Number of ratings	1259.39	1291.25	1594.28	1281.99

Availability of price offers across channels

Table 3 depicts basic information on the availability of price offers across the main distribution channels. In total, we observe 76 distinct sales channels in the Kayak data which can be classified as OTAs and direct channels.²⁶ We observe that hotels publish prices most often at the OTAs Booking.com, Expedia and HRS and the related OTAs of the same company groups (see Annex V for details).

Booking.com is the channel that exhibits the highest penetration as 96% of all hotels publish prices there at least once, followed by Expedia with 67% (Table 3, first data column). Across the covered countries, 31% of all hotels make use of the OTA HRS. In contrast, for Germany, around three quarters of all observed hotels had offers listed at

²⁶For our analyses we take into account that some OTAs belong to the same company group (see Annex V for details).

least once at HRS. This can be attributed to the fact that HRS is a German incumbent.²⁷

The high listing frequencies of the OTAs Booking.com, Expedia and HRS are consistent with a HOTREC survey from 2016 among more than 2,000 European hoteliers according to which the three major OTAs Booking.com, Expedia and HRS account together for more than 90% of all bookings in Europe.²⁸

Table 3: Channel use

Channel as displayed at Kayak (major channels only)	Fraction of hotels that used channel at least once	Frequency of channel use (given hotel used it at least once)
Direct channel (total)	16%	87%
Direct channel (independent hotel)	5%	71%
Direct channel (hotel chain)	11%	91%
Booking.com	96%	91%
Expedia	67%	91%
HRS	31%	78%
Base	All 29,497 hotels observed during the observation period	All Kayak requests of hotels after hotels have listed for the first time

Kayak displays a direct channel price of a hotel and provides a link to the hotel’s own website for approximately 16% of all hotels. Out of these hotels, about two thirds can be identified as chain hotels, whereas the other third are independent hotels. Among the 20 million Kayak requests, a direct channel offer is contained in 17% (not reported) of all requests on Kayak.

According to the Eurostat statistics on information and communication technologies use in tourism, 74% of all enterprises in the accommodation sector in Europe had a website that provided online ordering, reservation or booking opportunities in 2015. Therefore, it is not guaranteed that the direct channel listing observed on Kayak is fully representative

²⁷With respect to a comparison between countries, one further observes that Booking.com is the mostly used channel with a frequency ranging from 84% in Italy to 94% in Sweden and Austria. Number two is Expedia with frequencies from 45% in Austria to 83% in Canada. Compared to the channels Booking.com and Expedia that are very prevalent in all countries of the data set, the presence of the German OTA HRS varies more across countries. HRS is especially present in Germany (60%) and Austria (24%), while it appears only in 3% of all Canadian Kayak requests. Note that these figures are per listing.

²⁸Compared to the same survey conducted in 2013, bookings via OTAs have increased by 3 percentage points (pp) to 22%. Direct bookings account in total for 55% of all bookings and have dropped by 4 pp in the same time frame, while the direct online channel has remained approximately constant at close to 7% (HOTREC Survey on Hotel Online Distribution, <http://www.hotrec.eu/newsroom/press-releases-1714/dominant-online-platforms-gaining-market-share-in-travel-trade-no-signs-of-increased-competition-between-online-travel-agents-unveils-european-hotel-distribution-study.aspx>, last accessed December 1, 2017).

for all hotels with direct online channels. However, it is also not obvious why hotels with direct prices visible at Kayak should react in a systematically different way than other hotels.

Direct prices of chain hotels are over-represented on Kayak in relation to direct prices of independent hotels. In most of our analysis, we do distinguish between chain hotels and independent hotels.

The hotels do not always post prices at OTAs or list direct channel offers at Kayak (Table 3, second data column). A usage frequency of a channel below 100% arises if a hotel occasionally does not offer hotel rooms on the particular channel on Kayak. As we control for the date when a hotel starts to use a channel, these figures are a measure of the hotels' ability to react flexibly to changing market conditions on this channel. On average, a hotel that is at least once listed with Booking.com or Expedia offers rooms on the OTA in more than 90% of all Kayak requests. The direct channel of hotel chains exhibits a similar frequency as OTAs, while the direct channel of independent hotels is only used in 71% of all requests. Potentially, the lower listing frequency of independent hotels can be explained by different technologies of transmitting information to Kayak. Among all independent hotels that also list their direct channel on Kayak, more than 90% employ a third-party booking engine provider. In contrast, we find that around 85% of all chain hotels have their own booking engine to transfer data to Kayak (statistics by transmission technology not reported).

In the next section we develop the conjectures and the identification strategy for the empirical analysis.

4 Conjectures, identification and methodology

4.1 Conjectures

Pricing across channels

There are various reasons why a hotel might want to charge different prices on different distribution channels. On the one hand, direct channel customers might have a lower price elasticity than OTA customers as finding another hotel should be easier at an OTA. This

could favor higher direct channel prices. On the other hand, the marginal costs of a hotel for bookings on the direct channel are likely to be significantly lower than for bookings through an OTA because of the per-booking commission.²⁹ The “Book Direct” campaign of HOTREC³⁰ and similar measures of hotel associations indicate that hotels often favor direct channel bookings and might thus prefer to charge lower direct channel prices. The theoretical work of Shen and Wright (2017) confirms that when intermediaries (such as OTAs) determine the commission fees that sellers pay per transaction, the sellers have incentives to charge lower direct prices.

Both wide and narrow BPCs typically forbid hotels to have a lower price on the direct channel than on the OTAs. We therefore expect that without a BPC in place the direct channel has the strictly lowest price more often. We test

Conjecture 1. *The hotel’s direct online channel has the strictly lowest price (is the price leader) more frequently if the hotel faces no BPCs.*

Decision on which channels a hotel publishes prices

A price parity clause requires the hotel to not charge lower prices on certain other channels. Such a clause can make it unprofitable for some hotels to sign a contract with that OTA. A reduction of the parity clauses could therefore induce more hotels to sign a contract with the OTA at all and start publishing room prices there. Hence, we test

Conjecture 2. *If an OTA stops using parity clauses, more hotels become active at the OTA.*

For those hotels that have used the OTA before, the removal of the BPC might have two opposing effects. On the one hand, as a hotel is less constrained in its price setting, it could find it profitable to use the less constrained distribution channel(s) more intensively. In particular, it might have been unprofitable for the hotel to promote the direct channel when the hotel could not make the channel more attractive by means of a lower price.

²⁹Booking.com (and other major OTAs) typically act as “agents” for the hotels. In this agency business model, the customer formally does not purchase the hotel service from Booking.com, but does so from the hotel directly. Moreover, the hotel is responsible for the price setting on the OTA as on all other distribution channels. In return the OTA receives a commission payment from the hotels for every mediated booking.

³⁰See <http://www.hotrec.eu/bookdirect.aspx>; last accessed December 1, 2017.

Conjecture 3. *More hotels use the direct channel and make it visible at Kayak more often if they face less (stringent) parity clauses.*

On the other hand, we understand that the parity also requires some form of room availability.³¹ If the availability requirements exceed the number of offers a hotel would like to offer on the OTA, one might expect that a hotel offers rooms less often at an OTA once it is allowed to do so. On the contrary, a hotel might nevertheless be inclined to use the OTA more frequently following the removal of the BPC because it can now also differentiate between the other channels (in particular the direct channel) and that OTA channel by means of a lower direct price – instead of not listing at the OTA at all. We therefore test

Conjecture 4. *Hotels publish offers more frequently at an OTA if the OTA does not use parity clauses.*

4.2 Identification and methodology

As a first step, we investigate the pricing Conjecture 1 by means of cross-sectional statistics which capture differences across countries. In particular, we compare prices between channels in case of wide BPCs (as in Canada) with those in case of narrow and no BPCs (as in Europe). The identifying assumption here is that differences across countries are due to the different BPC regimes. We cannot exclude, however, that there are also other country-specific differences which affect the pricing across channels and the publishing of hotel offers online.

To account for country-specific differences, we test all our conjectures by investigating the effects of the latest prohibition decision in Germany, which was taken by the competition authority in December 2015 against Booking.com, with the obligation for Booking.com to remove the narrow BPC by February 2016.³² In particular, we compare a change in certain market outcomes in Germany with changes in other countries where the BPC policies did not change in 2016.

³¹Even Booking.com's narrow BPCs require from the hotel to make a minimum allocation of rooms on the OTA website available.

³²See Annex IV for an overview of the decisions.

We are not aware of other relevant regulatory changes for the investigated jurisdictions during our observation period. We have checked for relevant changes in taxation for our investigated countries by means of the IBFD tax research platform. There have been (slight) changes in the value added tax for accommodations in Austria in May 2016 and the corporate taxation in Italy in January 2017. To the extent that they apply to hotels, these should only affect a hotel's profit after taxes slightly and independently of the distribution channels used. As a consequence, these changes should have no significant impact on the participation of hotels in sites such as Booking.com and the pricing across distribution channels.

While we are not aware of any policy change in Canada, there have, however, been changes in the BPC policies in Europe before 2016. Across the whole European Union, Booking.com reduced the scope of its BPCs from "wide" to "narrow" by July 2015.³³ This took place well before our observation period and if it had an effect at all, it should have affected all European member states equally. In case of France, the parliament in addition prohibited BPCs of all OTAs in the summer of 2015. We therefore compare the developments in Germany with the developments in the countries of the control set one by one. By showing that the developments of our dependent variables are distinctively different from the developments in all (or at least most) of our control countries, we are confident that our results are not driven by certain other developments in a particular control country.

In our main specification, we compare the *trends* in the market outcome in Germany in the course of 2016 with the trends in other countries without such a change of the BPCs. Our identifying assumption for this approach is that the *difference-in-trends*³⁴ can be attributed to the removal of Booking.com's narrow BPC in Germany and that there are no other country-specific developments since January 2016 which affect the pricing across channels and the publishing of hotel offers online, except for demand and OTA popularity, which we control for with the following variables:

³³See footnote 3.

³⁴This closely resembles a difference-in-differences approach as a trend is a difference over time. Because of the short pre-treatment period, we rely on the null hypothesis is that the trends in the different countries over one year should not vary systematically from the German trend if the change in the BPC regime in Germany has no effect. In Annex VIII we provide evidence that a standard difference-in-differences specification yields qualitatively the same result.

1. The share of non-listed hotels at the city-level, according to Kayak, which approximates the occupancy rate at the travel date from the perspective of the search date,
2. the worldwide search volume for hotels in each city of our data set on Google, as an approximation for actual demand at the search date, and
3. the country-specific search volume for each of the three main OTAs on Google, which accounts for a potential different development of the popularity among customers.

We conduct various auxiliary analyses to ensure that we correctly identify the effects of the removal of the BPC in Germany (see Section 7 for details):

1. We address the concern that within-year changes could be due to a particular seasonality in Germany by analyzing the development over a year, both by means of a linear trend over the period of January 2016 to January 2017 as well using two-months-country-fixed effects and comparing the base period of the beginning of 2016 with the fixed effect of the first month in 2017.
2. We analyze short term changes in Germany relative to the other countries. The closeness in time between the policy change in and distinct changes in the dependent variables can be seen as an indication of a causal relationship.
3. As we only have a short pre-treatment period in the detailed Kayak data, we additionally study time series which go back to the years before 2016 to rule out that Germany is on a different long term trend than the control countries.

For the main regressions, we estimate several equations of the following kind:

$$y_{i,c,t,d} = \beta_1 trend_t + \beta_2 trend_t I_c + \beta_3' X_{i,c,t,d} + \varepsilon_i + \epsilon_{i,c,t,d}, \quad (1)$$

where i denotes the hotel, c the country (which is constant for each hotel), t the travel date and d the booking date (when appropriate). The dependent variable $y_{i,c,t,d}$ is a dichotomous variable. Depending on the conjecture to be tested, this is an indicator of a certain channel having the lowest price or of the availability of a hotel offer on a

channel. We measure changes over time in our reference country (Germany) by including a linear trend. To capture diverging developments in other countries, we interact this trend variable with indicator variables for other countries (I_c).

The vector X controls for other time-varying factors. If not stated differently, we include as control variables the time interval between booking date and travel date, the weekday of the first travel day, the rating of the hotel as it is displayed at Kayak. To control for demand and OTA popularity, we also include the share of non-listed hotels for that travel date in the city where the hotel is located and the Google Trends time series, as discussed above.

We control for time-constant heterogeneity between hotels by means of hotel fixed effects ε_i . For instance, factors like the hotel size or the hotel’s sales strategy might influence where a hotel publishes prices and how it sets prices across channels. To the extent that the influence stays constant in the course of our observation period, it is captured by the hotel fixed effects. This leaves us with the within-hotel variation. As a consequence, other time-constant observed variables such as hotel stars or the country are not included in the regression analyses.³⁵

As we also observe whether a hotel belongs to a hotel chain or is an independent hotel, we explicitly allow for heterogeneity between these different types of hotels. For our main analyses, we therefore conduct the fixed effects regressions separately on the population of chain hotels and independent hotels in order to identify hotel-type-specific developments. For the analysis of changes in the general availability of hotels on specific channels over time, we slightly change model (1) and estimate the following model:

$$y_{i,c,t} = \beta_1 trend_t + \beta_2 trend_t I_c + \beta_3' X_{i,c,t} + \varepsilon_i + \epsilon_{i,c,t}. \quad (2)$$

In model (2), the subscript d is dropped as we aggregate the observations to the hotel-month-level such that we have one observation for hotel i in country c in month t . Correspondingly, vector X contains only the average monthly share of non-listed hotels in this month in the corresponding city, the aggregated hotel rating in this month and the monthly averages of the Google Trends data.

³⁵As a robustness test, we run regressions without fixed effects in Annex VII.

Due to the high computational effort in case of fixed effects, we conduct the regressions on dichotomous indicator variables with the linear probability model (LPM) rather than with an index model such as probit and logit. Although such a non-linear model is theoretically a more rigorous approach, we follow Wooldridge (2010) that the LPM often yields good estimates of the partial effects on the response probability. We compute standard errors that are robust to heteroscedasticity and serial correlation at the hotel-level.³⁶

5 Pricing across channels

5.1 Cross-sectional observations

Finding 1: The direct channel price is more often below the Booking.com price in Germany and France (largely no BPCs) than in Canada (wide BPCs).

To investigate the pricing across distribution channels, we first compute how often the direct channel price is strictly below or above the price of the major OTAs at the country-level. Table 4 shows for each country and hotel type the share of Kayak requests in which the Booking.com price is above the direct channel price ($B > D$) and vice versa ($D > B$).³⁷ The share of observations with price parity ($D = B$) is implicitly given as 100% minus both shares. We group the countries by BPC regime. The numbers in parentheses show for each country the number of Kayak requests in which both Booking.com and the direct channel are listed.

The price relation is possibly measured with some error, although we have not found any indication of a systematic measurement error.³⁸ A potential error may thus materialize in both directions ($B > D$ versus $D > B$) with the same likelihood. On this basis, we can compute a conservative measure of the frequency of the event ($D < B$), called *difference*, by subtracting the fraction of Kayak requests in which the direct price is larger than Booking.com ($D > B$) from the fraction in which the direct price is smaller than the Book-

³⁶As a robustness check, we have computed standard errors also at the city level and the country-chain level, but found that our main results were mainly unaffected.

³⁷The analogous computations for the relation between the direct channel and Expedia as well as HRS yield similar results.

³⁸See Section 7 and Annex II for details.

ing.com price ($B > D$). The *difference* leaves us with a lower bound of the frequency with which hotels price the direct channel cheaper than Booking.com, which would materialize if all observed ($D > B$) cases were due to an unsystematic error.

Table 4: Relation between Booking.com and direct channel

Country	Chain			No Chain		
	B>D	D>B	Difference	B>D	D>B	Difference
<i>No BPC</i>						
Germany* (n=648,620)	31.4	14.7	16.4	65.4	16.8	48.6
France (n=1,086,796)	28.9	18.1	10.8	65.0	15.4	49.6
<i>Narrow BPC</i>						
Italy (n=359,831)	31.4	22.5	8.9	55.2	19.9	35.3
Sweden (n=129,203)	41.5	23.9	17.6	52.1	29.9	22.2
Austria** (n=143,145)	31.0	21.2	9.8	52.6	21.3	31.3
Others (n=165,736)	35.9	26.2	9.7	37.8	26.5	11.3
<i>Wide BPC</i>						
Canada (n=676,509)	29.2	32.8	-3.6	34.7	33.0	1.4

The column variables indicate the share of Kayak requests (in %) for which the particular relation (e.g. $B > D$) holds. The net effect is the difference between the two numbers to control for potential measurement errors. *Booking.com removed the narrow BPC in February 2016. **In Austria, narrow BPCs were in place until December 2016.

Table 4 shows that in Canada this *difference* – taken as a conservative measure of the fraction with a lower direct channel price – is at minus 3.6% for hotel chains and at 1.4% for independent hotels. This suggests a possibly high compliance towards wide BPCs in Canada.³⁹ In contrast, in countries where no BPCs are in place the aggregated measure of a lower direct channel price is considerably higher and between 16% for France and 20% for Germany (aggregated values not reported in the table). This comparison confirms Conjecture 1 that the direct channel is more frequently below the price at an OTA if no BPC is in place.

Table 4 also shows that in the countries with narrow BPCs the direct channel is more often cheaper than Booking.com. This observation strongly suggests that direct channel prices covered by a narrow BPC are below the price at Booking.com in a considerable number of cases. The fact that we do not observe similar results for the narrow BPC

³⁹A certain degree of non-compliance even in case of wide BPCs is plausible. For instance, the monitoring report of various European competition authorities states that “evidence from the NCA antitrust cases suggests that many hotels did not fully comply with their parity obligations under wide parity” (fn. 17 therein).

countries as for Canada suggests that OTAs in these countries cannot enforce price parity between the direct channel and the OTA in the same way as it is feasible in Canada. This observation is interesting as one might expect the same compliance in relation to the direct channel price under a narrow and a wide BPC because both restrict the direct channel price not to be lower than the OTA price. Less compliance in case of narrow BPCs might be due to other restrictions that are relaxed in the narrow parity clauses of Booking.com, such as limited punishments in case of non-compliance. The competition policy cases run against Booking.com might have also weakened the enforcement power of Booking.com.

The comparison between chain hotels and independent hotels indicates that the direct channel is more often cheaper than Booking.com among independent hotels, which suggests a lower compliance with parity clauses of the latter. Moreover, according to our data, independent hotels in Germany and France – where Booking.com was not allowed to use parity clauses anymore in our observation period – price the direct channel cheaper than Booking.com most often.

Finding 2: Kayak shows one channel as price leader across sales channels in about half of all observations.

For Kayak requests with prices from at least two channels, Table 5 displays the cross-sectional frequencies of the event that the second lowest price is strictly higher than the lowest price (existence of a strict price leader). The absolute numbers should be interpreted very cautiously as they might suffer from measurement error, similar to the price relations presented before.

It is more insightful to compare the figures across countries as this is robust to unsystematic data errors (for instance due to delayed updating of prices by Kayak). An interesting observation is that the direct channel of independent hotels is the price leader more often in countries where OTAs largely do not have best price clauses, foremost France and Germany (data column 4). The fraction is also relatively high in Austria, where the legal prohibition was arguably already foreseeable for hotels in the course of 2016. Moreover, the direct channel is by far least often the price leader in the wide BPC country Canada. This finding is consistent with Conjecture 1. For chain hotels, the pattern is similar in

that France has the highest share of direct price leadership and Canada the lowest fraction, but the shares are more similar and overall the pattern is less clear (data column 3).

Table 5: Share of Kayak requests with price leader and frequency of direct channel and Booking.com as price leader by chain

Country	Existence price leader		Share direct channel		Share Booking.com	
	Share	Deviation	Chain	No chain	Chain	No chain
<i>No BPC</i>						
Germany* (n=4,169,477)	39.4	10.9	10.7	41.8	5.3	12.3
France (n=4,741,024)	48.9	9.2	15.0	42.2	8.4	15.1
<i>Narrow BPC</i>						
Italy (n=6,327,717)	50.0	19.6	8.4	27.8	6.5	24.1
Sweden (n=596,213)	44.2	10.1	10.8	18.6	12.2	14.5
Austria** (n=1,032,744)	50.2	12.6	10.2	39.5	8.3	23.8
Others (n=1,416,241)	57.8	17.8	11.6	14.6	9.6	24.9
<i>Wide BPC</i>						
Canada (n=1,831,876)	53.1	10.3	9.0	10.4	10.7	23.4

The first two columns indicate the share of Kayak requests with at least two listings (in %) with a strict price leader (1) and the the average relative deviation to the second lowest price (2). Columns 3 to 6 show by hotel type how frequently the direct channel and Booking.com are the price leader among the requests in which they are listed. *Booking.com removed the narrow BPC in February in 2016. **In Austria, narrow BPCs were in place until December 2016.

In order to control for potential time-constant country and hotel-specific differences across BPC regimes, we analyze the effects of Booking.com’s removal of the narrow BPC in Germany on the price leadership of the direct channel and Booking.com in the next subsection.

5.2 Effects of Booking.com’s removal of the narrow best price clause in Germany on pricing

Finding 3: The direct price of chain hotels in Germany is increasingly often the strictly lowest online channel price.

According to Conjecture 1, the hotels’ direct online channel should more often have the strictly lowest price on offer (price leader) following the removal of the narrow BPC of the largest OTA Booking.com. In Germany, the formerly largest OTA HRS had already been

prohibited to use any BPC in 2013, whereas the investigation of the narrow BPCs of the third largest OTA Expedia is still ongoing. For hotels that do business with Expedia, a narrow BPC might therefore still be in place and would formally not allow them to offer a lower direct price. However, our anecdotal evidence – derived from several phone calls with hoteliers in Germany in 2016 – suggests that hoteliers might not respect Expedia’s clause very much in view of the ongoing investigation and the previous prohibitions against HRS’s wide and in particular Booking.com’s narrow BPCs.

Table 6 displays regression results separately for chain hotels and independent hotels. The dependent variable is equal to 100 if the direct channel (first and third data column) or Booking.com (second and fourth data column) has the strictly lowest price on offer, and is 0 otherwise. The linear country-specific trend captures whether the particular distribution channel becomes price leader more often. For the regressions we only include observations of hotels that have used the particular channel already at the beginning of the observation period and Kayak requests that contain a Booking.com and a direct channel listing.⁴⁰

In Germany, there is a positive trend of the direct channel of chain hotels being the price leader (0.36 pp per month, see Table 6, data column 3). For all other countries the coefficients indicating the difference from the German trend are negative, with particularly large and significant values for France, Italy and Sweden. For Austria, which has gone through the process of a legislative prohibition of the BPCs in 2016, there is no significantly different trend from Germany. We obtain the same result for Canada. By contrast, for the independent hotels (data column 1) there is no significant time trend with respect to the direct channel. Recall that independent hotels in Germany on average price the direct channel relatively often lowest (Table 5), and in particular below their price at Booking.com (Table 4). It might therefore be that these hotels are generally less compliant than chain hotels and therefore responded less strongly in their pricing to the removal of the narrow BPC of Booking.com.

While the direct channel is more often the price leader within the group of chain hotels, we find that Booking.com is significantly less often the price leader (minus 0.20 pp per

⁴⁰For all countries except of Austria the beginning of the observation period is defined as hotels that have used the particular channel already in February 2016. As the data collection for Austria started later, we extend this time frame for Austria until April 2016.

month, data column 4) among these hotels in Germany. In particular, this development is different in France, Italy and Canada, where the frequency of Booking.com as price leader does not decrease. As regards the price leadership of Booking.com among independent hotels, the regression results suggest that these hotels on average price Booking.com more often lowest (0.46 pp per month, data column 2). However, this trend in Germany in itself only weakly significant and not significantly different from the trend in various other countries, including Italy and Sweden.

If we pool all hotels together, the result that the direct channel becomes the price leader significantly more often in Germany prevails, while Booking.com is the price leader significantly less often (see Annex VII, Table 24 and 25 for details).

Chain hotels set the strictly lowest price on their direct online channel more often and less often on Booking.com when more hotels in their city are not listed. They also set more often a strictly lowest price - both on the direct channel and Booking.com - when demand is high (as measured by GT city). The respective results for independent hotels are less conclusive, as coefficients are partly not significantly different from zero. However, the popularity of Booking.com (measured by GT Booking.com) affects for both hotel types the likelihood of setting a strictly lowest price on Booking.com positively.

In additional robustness analyses, we observe that the direct channel is more often the price leader, even if we define a price leader to have a discount of at least 5 percent to the second lowest price. This result lets us conclude that the hotels that are inclined to change their price setting do so up to a price adjustment of 5 percent. For an average price of 120 EUR in our data, this means that the direct channel is more often 6 EUR or even more below the second lowest price. The result on the price leadership of Booking.com is only robust to a threshold of 1 percent. However, note that the event of an OTA price being for instance 5 percent below the second lowest price is not really influenced by the abolition of a narrow BPC.⁴¹

⁴¹More specifically, following a suggestion of a referee, we have rerun the regressions with a more restrictive definition of price leadership. In particular, we defined a price leader only if it the corresponding price was at least 1% (5% and 10%) lower than the second lowest price. The corresponding results are available upon request.

Table 6: Channel has the strictly lowest price

	No chain		Chain	
	(1) Direct	(2) Booking.com	(3) Direct	(4) Booking.com
Trend (Base: Germany)	-0.68 (0.60)	0.46* (0.26)	0.36*** (0.09)	-0.20*** (0.04)
Δ Trend France	0.39 (0.69)	-0.39 (0.28)	-0.77*** (0.11)	0.28*** (0.06)
Δ Trend Italy	1.44* (0.78)	-0.37 (0.30)	-0.58*** (0.16)	0.33*** (0.08)
Δ Trend Sweden	-1.05 (0.97)	-0.21 (0.33)	-1.61*** (0.30)	0.04 (0.12)
Δ Trend Austria	0.49 (0.80)	-0.89** (0.35)	-0.31 (0.20)	-0.21** (0.10)
Δ Trend Canada	0.21 (0.63)	-0.75** (0.32)	-0.17 (0.11)	0.18** (0.08)
Δ Trend Other countries	0.16 (0.66)	-0.07 (0.31)	-0.23 (0.21)	0.36** (0.16)
Share of non-listed hotels	0.01 (0.03)	0.02 (0.02)	0.02*** (0.01)	-0.02*** (0.01)
Kayak hotel rating	-4.00 (3.03)	3.66** (1.47)	1.61 (1.11)	1.67* (0.98)
GT city	-0.02 (0.03)	0.05*** (0.01)	0.03*** (0.01)	0.02** (0.01)
GT Booking.com	-0.01 (0.02)	0.06*** (0.01)	0.01* (0.01)	0.18*** (0.01)
7 days before	-1.60*** (0.47)	-1.49*** (0.25)	0.06 (0.17)	-1.64*** (0.14)
14 days before	-1.34*** (0.49)	-0.90*** (0.29)	-0.14 (0.18)	1.16*** (0.17)
21 days before	-0.25 (0.58)	-1.55*** (0.30)	0.98*** (0.22)	-2.04*** (0.16)
28 days before	0.05 (0.62)	-2.20*** (0.32)	1.45*** (0.23)	-3.71*** (0.18)
Weekdays	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	Yes
Observations	481,064	495,315	2,486,955	2,408,906
R^2	0.466	0.202	0.388	0.137
Adjusted R^2	0.465	0.201	0.387	0.136

Standard errors (clustered by hotel) not reported. Only observations of hotels included that have used the particular channel already at the beginning of the observation period and that contain a direct channel and Booking.com listing. Dependent variables are equal to 100 if particular channel is price leader and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Taken together, the regression results are consistent with Conjecture 1 in that the direct channel in Germany is becoming the price leader more often in response to the removal of Booking.com's narrow BPC. At the same time, the OTA Booking.com, is less often the price leader in Germany. The finding that the direct channel becomes the price leader more often is driven by the chain hotels which we found to be more compliant in general. For this group of hotels, we find that only around 6 percent of the observations from Germany have listed the direct channel as a price leader at the beginning of the observation period. The regression results suggest that this fraction increases by 4.32 pp throughout the observation period. This implies an increase of 70 percent in observations with a direct price leader compared to the level of the beginning of 2016.

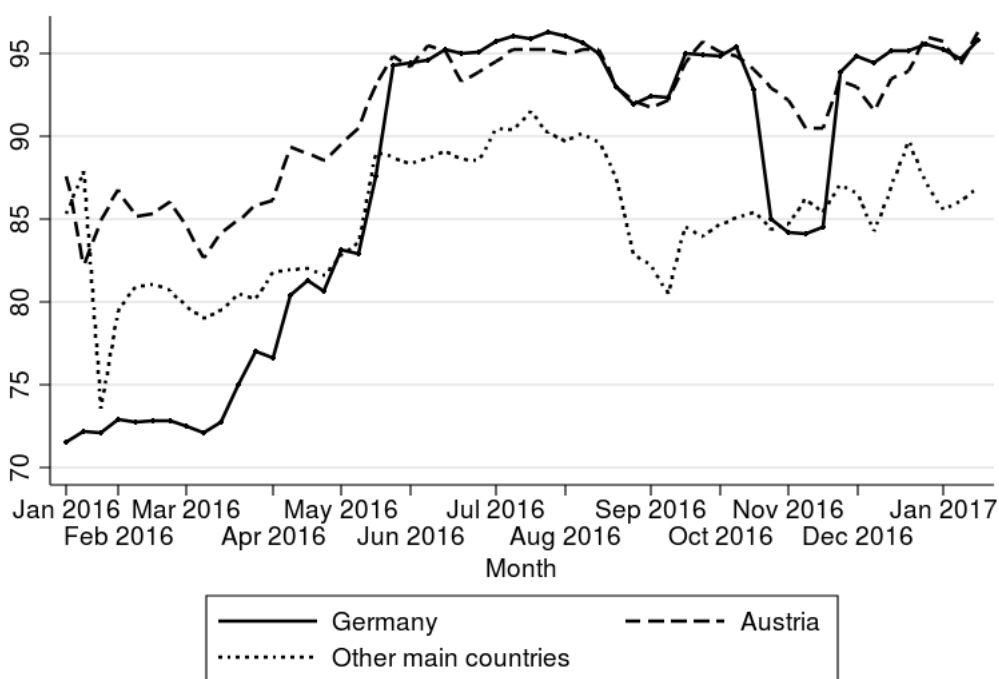
6 Analysis of hotel room availability across channels

In this section we study the effects of Booking.com's removal of the narrow best price clause in Germany on the availability of online price offers. Across all the countries in our data, the frequency of price publications at Booking.com increases over time (Figure 2). This indicates Booking.com's growing importance in online hotel distribution. The frequency in Germany starts from an average level of around 73% and exhibits a drastic increase at the beginning of the observation period.⁴²

We analyze below whether the increased listing frequency can be attributed to the abolition of Booking.com's BPC in Germany, as the implied less restrictive contract terms might make it more attractive for hotels to list on Booking.com. The following regressions address the intensive and extensive publication decisions (Conjectures 2, 3 and 4).

⁴²During November 2016 one can observe a drop of around 10% in the frequency of Booking listings for Germany. We understand from hoteliers that technical problems with the interface occurred during this period, which could explain the temporary non-availability of hotels as shown in our data. Additionally, a new API by Booking.com was rolled out in this month, which could also have had an impact.

Figure 2: Booking.com listing frequency at Kayak by country



Weekly Booking.com frequency. Data collection for Austria was extended in April 2016 from 2 to 30 cities.

Finding 4: More hotels make price publications at Booking.com in Germany following the removal of the narrow BPC (extensive margin).

According to Conjecture 2, a reduction in the scope of a BPC should yield an increase in price publications at the extensive margin, especially for the OTA that narrows down its BPC. This can be tested for Germany where Booking.com had to waive its narrow BPC from February 2016 onward.

Again, we test this conjecture separately for chain and independent hotels. For this analysis we use a data set where each observation corresponds to a hotel in a specific month. The dependent variable equals 100 if a particular channel (such as Booking.com) was used by the hotel at least once in that month according to the Kayak data, and 0 otherwise. The linear country-specific trend captures whether hotels use the channel in later months but not early in 2016 (extensive use). The hotel rating, the Google Trends data and the share of non-listed hotels are aggregated to the monthly average for the respective hotel or destination.⁴³ We report the regression results in Table 7.

⁴³The control variables for the time interval between booking and travel date and the weekday of the first travel day are not included.

Table 7: Extensive channel use (at least once in a month)

	No chain		Chain	
	(1) Direct	(2) Booking.com	(3) Direct	(4) Booking.com
Trend (Base: Germany)	0.09*** (0.02)	1.68*** (0.07)	0.01 (0.05)	2.01*** (0.11)
Δ Trend France	0.04 (0.05)	-0.65*** (0.09)	0.08 (0.07)	-1.35*** (0.12)
Δ Trend Italy	-0.13*** (0.03)	-0.02 (0.08)	-0.15 (0.10)	-0.89*** (0.17)
Δ Trend Sweden	-0.01 (0.10)	-1.89*** (0.09)	-0.19** (0.09)	-2.09*** (0.12)
Δ Trend Austria	-0.09 (0.07)	-0.91*** (0.10)	0.26* (0.14)	-1.51*** (0.14)
Δ Trend Canada	-0.10* (0.05)	-1.77*** (0.08)	-0.04 (0.07)	-1.91*** (0.11)
Δ Trend Other countries	-0.14*** (0.05)	-1.70*** (0.07)	0.58*** (0.19)	-1.90*** (0.13)
Avg. share of non-listed hotels	-0.00 (0.00)	-0.11*** (0.01)	0.01 (0.01)	-0.12*** (0.02)
Avg. Kayak hotel rating	0.23 (0.19)	1.79*** (0.54)	0.87 (0.98)	0.48 (1.29)
Avg. GT city	0.00 (0.00)	-0.03*** (0.00)	0.00 (0.01)	-0.03*** (0.01)
Avg. GT Booking.com	-0.00 (0.00)	0.15*** (0.00)	-0.01 (0.01)	0.13*** (0.01)
Weekdays	No	No	No	No
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	Yes
Observations	212,673	212,673	70,716	70,716
R^2	0.874	0.523	0.950	0.483
Adjusted R^2	0.859	0.467	0.946	0.435

Standard errors (clustered by hotel) not reported. Dependent variable is equal to 100 for all months in which a hotel used the particular channel at least once and 0 otherwise.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The second and fourth data column of Table 7 show a positive trend in the share of hotels in Germany using Booking.com at least once in each month. The share increases on average by 1.7 pp per month for independent hotels and by 2 pp per month for chain hotels. The coefficients on the interactions of the time trend with the other countries (i.e. the deviations from the German trend) are significantly negative (except for one case of insignificance). These time trends are thus less pronounced for the other countries, where

no change in the BPC regime took place in the investigated time frame. The negative and significant deviations (in absolute values) from the German trend range from 0.65 pp in France (independent hotels) to approximately 2 pp in Canada and Sweden (chain hotels). As a result, in these countries the trend of Booking.com's extensive price publications is close to zero.

The significant and positive coefficient on the extensive direct channel use of 0.09 pp for independent hotels in data column 1 might allude to the fact that Booking.com's narrow BPC indeed put a constraint on the direct channel. After its abolition, it might be reasonable for more independent hotels to engage in direct online sales. For chain hotels we do not find an increase in the extensive direct channel use (possibly because they marketed the direct channel already more actively before).

The regressions on the extensive channel use of Booking.com confirm Conjecture 2: There is a significant positive trend in the extensive channel use of Booking.com following the removal of its narrow BPC in Germany. This trend is significantly stronger than in the other countries. The regression results suggest that this increase is at 20.1 (24.1) pp for independent hotels (chain hotels) in Germany. To put this into perspective, we relate this increase to the extensive Booking.com use in Germany at the beginning of the observation period in Germany, which is around 75 percent. In relation to the implied increase of extensive Booking.com use, this suggests that extensive Booking.com use has increased by 26.4 (31.7) percent for independent hotels (chain hotels) in Germany compared to the initial level at the beginning of 2016.

The direct sales channel of independent hotels in Germany also seems to be positively affected by the abolition of Booking.com's narrow BPC (although the development is less Germany-specific). That we observe a rather strong increase in fraction of hotels using Booking.com at all is in line with the argument underlying Conjecture 2 that hotels are now particularly more willing to register with this OTA as they are not constrained by its BPC anymore.

Finding 5: Hotels make price publications more frequently at Booking.com following the removal of the narrow BPC (intensive margin).

We now analyze the intensive channel use of Booking.com and the direct channel. We measure the intensive channel use as the frequency with which prices for a hotel on a particular channel are available in those Kayak search responses with at least one price offer for that hotel. We conduct the analysis of hotels for which we observe prices on this channel already at the beginning of the observation period in the Kayak data. According to Conjectures 3 and 4, we expect that BPCs lead to less frequent price publications, both at the OTA using the clause as well as at channels covered by the clauses. In Germany, Booking.com had to abolish its narrow BPC that explicitly only restricted the price setting on the direct online channel. As a consequence, the removal of the BPC should increase the frequency at Booking.com and the presence of direct prices at Kayak because hotels can use these distribution channels now more flexibly.

We test this conjecture with separate regressions for each of the channels. The dependent variable equals 100 if the channel price is shown in response to the Kayak request, and 0 otherwise. Again, we split the sample into hotel chains and independent hotels and – as mentioned above – only include observations of hotels which have used the respective channel already at the beginning of the observation period.⁴⁴ This measures whether the channel is used more intensively in later months than early in 2016. Note that we control for the hotel rating, OTA popularity according to Google as well as local supply-demand balance by means of the share of non-listed hotels at Kayak and the Google Trends measure of the destination popularity.

We find that both independent and chain hotels increase the frequency of price publications at Booking.com significantly over time in Germany (Table 8 data columns 2 and 4). The negative deviations from the Germany trend suggest that the changes in the intensive use of Booking.com are weaker in most of the other countries. An exception is Austria, where trend in intensive channel use of Booking.com is significantly stronger for both types of hotels. These results might indicate that Austrian hotels undergo a similar development as in Germany as narrow BPCs were in the public legislative process of being prohibited in Austria in 2016. Interestingly, the popularity measure for the OTA Book-

⁴⁴See footnote 40.

ing.com indicates that hotels of all types particularly rely on this distribution channel in destinations and at times in which many (potential) customers search for hotel rooms via Booking.com. Accordingly, in these instances the direct channel is used less intensively. For the direct channel of independent hotels we do not see a trend in Germany that is statistically different from zero. However, we observe negative significant coefficients for France and Italy. In contrast, for the direct channel of chain hotels we find that the listing frequency increases significantly by 0.4 pp per month (data column 3). The coefficients for the deviations in the other countries are mostly significantly negative. For the direct channel of hotel chains we observe statistically significant deviations from the German trend in France, Sweden and Canada. The trends in Austria and Italy are not significantly different from the German trend, indicating similar developments as in Germany. Hence, this confirms Conjectures 3 and 4 for the chain hotels (and partly also for the independent hotels) because especially the hotel chains harness the less restrictive contract terms in order to offer hotel rooms more frequently at Booking.com and their direct channel (as it is visible at Kayak).

Taken together, the regression results confirm Conjectures 3 and 4 by indicating that the abolition of Booking.com's narrow BPC is related to an increase in the intensive channel use for those hotels that adopted Booking.com already. The results show that chain hotels use both Booking.com and the direct channel more intensively by 4.8 pp in the span of the observation period. Compared to the intensive channel use at the beginning of 2016 which is around 90 percent for both channels, this implies that chain hotels make 5.2 percent more use of Booking.com and the direct channel. Similarly, the results suggest that the independent hotels in Germany make 2.4 percent more use of Booking.com relative to an initial channel use of around 95 percent.

The narrow BPC required the direct online channel price not to be lower than the price at Booking.com. Now hotels publish their prices more often also at Booking.com. This might be the case because it is possible to be visible at Booking.com and to set lower prices at the direct channel than at Booking.com at the same time, while before part of the hotels might just not have published offers at Booking.com in such instances.

Table 8: Intensive channel use (if used at the beginning of observation period)

	No chain		Chain	
	(1) Direct	(2) Booking.com	(3) Direct	(4) Booking.com
Trend (Base: Germany)	-0.33 (0.46)	0.18*** (0.04)	0.40*** (0.09)	0.40*** (0.03)
Δ Trend France	-1.33** (0.55)	-0.08 (0.06)	-0.36*** (0.11)	-0.48*** (0.05)
Δ Trend Italy	-3.13*** (0.57)	-0.59*** (0.06)	-0.03 (0.17)	-0.39*** (0.11)
Δ Trend Sweden	-0.35 (0.78)	-0.10 (0.07)	-0.57*** (0.22)	-0.05 (0.06)
Δ Trend Austria	-0.28 (0.76)	0.28*** (0.09)	0.39 (0.24)	0.28*** (0.11)
Δ Trend Canada	-0.43 (0.54)	-0.19*** (0.07)	-0.22* (0.12)	-0.04 (0.05)
Δ Trend Other countries	-0.58 (0.60)	0.02 (0.05)	-0.32 (0.24)	-0.08 (0.07)
Share of non-listed hotels	-0.43*** (0.03)	-0.25*** (0.01)	-0.29*** (0.01)	-0.34*** (0.01)
Kayak hotel rating	-0.29 (3.50)	0.68 (0.53)	-0.71 (1.13)	-0.83 (0.86)
GT city	-0.17*** (0.03)	-0.06*** (0.00)	-0.07*** (0.01)	-0.10*** (0.00)
GT Booking.com	-0.16*** (0.02)	0.03*** (0.00)	-0.02*** (0.01)	0.05*** (0.00)
7 days before	1.51*** (0.26)	0.15** (0.06)	0.19** (0.08)	-0.33*** (0.07)
14 days before	2.01*** (0.28)	0.14** (0.07)	0.58*** (0.09)	-0.09 (0.09)
21 days before	2.23*** (0.32)	0.10 (0.08)	0.51*** (0.10)	0.09 (0.09)
28 days before	2.56*** (0.35)	-0.09 (0.08)	0.54*** (0.11)	0.02 (0.10)
Weekdays	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	Yes
Observations	755,437	11,375,241	2,967,784	4,909,284
R^2	0.510	0.233	0.273	0.120
Adjusted R^2	0.509	0.232	0.273	0.119

Standard errors (clustered by hotel) not reported. Only observations of hotels included that have used the particular channel already at the beginning of the observation period. Dependent variables are equal to 100 if particular channel is present at Kayak request and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

7 Robustness checks

We summarize our various robustness checks in this section. In Subsection 7.1, we look at within-year variations, including possible seasonality effects. In 7.2, we analyze long-term trends that our Kayak data cannot fully capture. In 7.3 we elaborate on potential measurement errors in the Kayak data.

7.1 Potential parallel developments and seasonality

Our identifying assumption for our empirical investigation is that the distinct development in Germany relative to the other countries is attributable to the removal of Booking.com’s narrow BPC in Germany. In order to substantiate our claim that no other country-specific developments other than the BPC drive our result, we conduct the following robustness checks.

First, we address the possibility that country-specific seasonality is responsible for the observed results with a specification that allows more flexibly for country-specific seasonal developments than the linear trend. By estimating two-month indicators for each country, we can directly compare the base period of the beginning of 2016 with the first period in 2017. This comparison yields a seasonality-adjusted measure of our estimates. The results are comparable to those obtained for the linear trend specification (see Annex VIII).

Second, we restrict the sample to the period January to July 2016 in order to look for short term effects. In addition, we also focus on hotels that change their listing or pricing behavior and run regressions without hotel fixed effects. Again, the results are comparable to the main specification (see Annex VII).

Finally, we investigate the comparability of the initial listing frequencies of Booking.com in Germany and the control group. In the spirit of a matching approach, we show that the results with respect to the listing frequencies of prices at Booking.com are also obtained when restricting the control group to cities which had a comparable listing frequency as the German cities initially in our observation period. This provides a strong indication that the developments in Germany are not just a simple “catch-up” process due to possibly different initial listing frequencies of hotels across countries (see Annex VI).

7.2 Long term trends

The Kayak data that we use in our analysis covers the period January 2016 to January 2017. In order to address the concern that the developments found in our Kayak analysis might be due to longer term trends that started before our observation period, we also compare developments in the relevant outcomes for the different countries prior to our Kayak observation period.

To substantiate the finding that the ban of Booking.com's BPC in Germany led to an increase in hotel registrations on Booking.com, we collected registration dates of the hotels in our sample directly from Booking.com.⁴⁵ This allows us to study the development of registrations by hotels on Booking.com for Germany, Austria, France and the other main countries as a moving three-month average in Figure 3. Similar to the Kayak data plots in Figure 2, there is a sharp increase in the number of newly registering hotels Germany in 2016. This increase is clearly higher than any increase in the previous five years. This also confirms that the evolution of listing frequencies as observed at the meta-search site Kayak is plausible. Another sharp increase can be observed in France slightly earlier. This might be related to the removal of all BPCs in France by law in the second half of 2015. More importantly, the graph suggests for the remainder that the developments of registrations are similar across time and countries.

Furthermore, we study the development of the popularity of Booking.com over time for each country in Figure 4. The graphs confirm that there is no obvious Germany-specific development in the popularity of Booking.com from the customer perspective, when comparing across time and country. This reassures us that our main results are not driven by a longer term trend which is not fully captured in our Kayak data.

⁴⁵For this, we queried the website Booking.com directly for the same set of travel destinations in September 2016 over a time period of four weeks. We subsequently accessed the respective hotel profile websites on Booking.com and gathered the official entry date ("...has been welcoming Booking.com guests since...") as of the 30th of September.

Figure 3: Number of new hotels registered on Booking.com (3 months moving average)

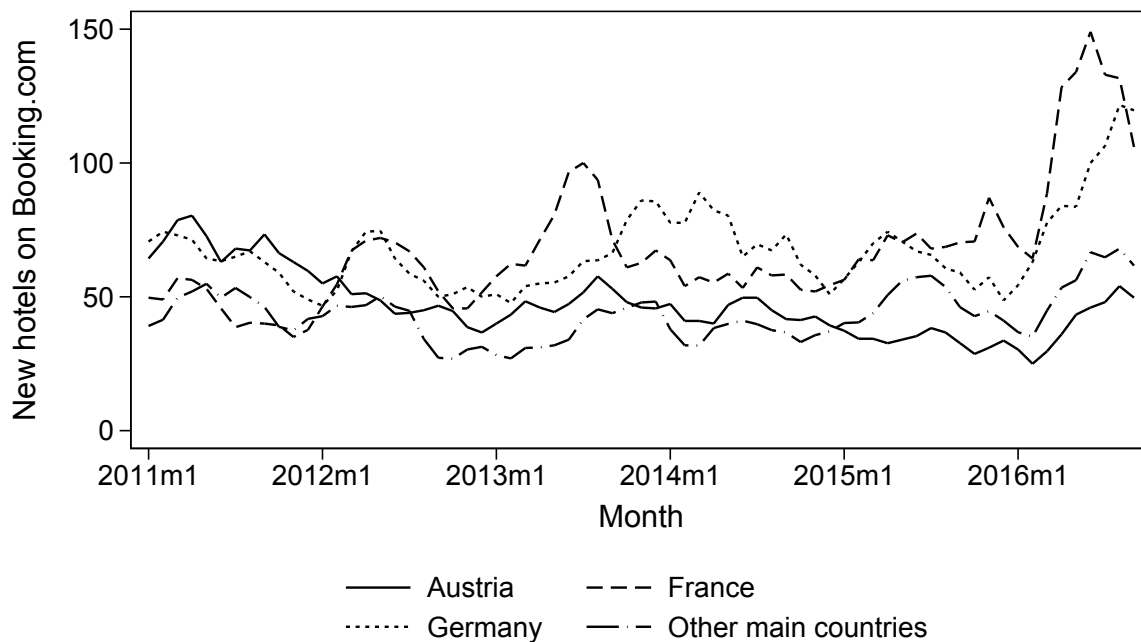
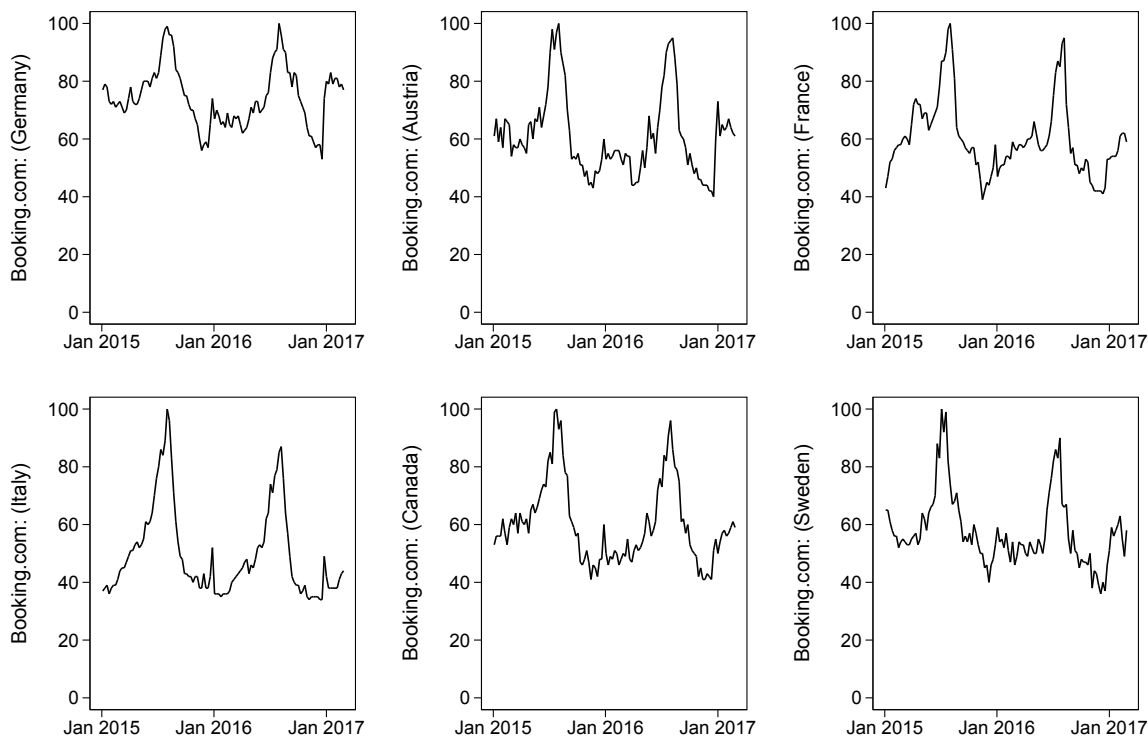


Figure 4: Relative search volume directed to Booking.com on Google



7.3 Measurement error

One may be concerned whether there is a potential measurement error in the Kayak prices. For example, in response to one of our Kayak requests, Kayak might return the

up to date price of Booking.com but a slightly older price for the direct channel, where in the meantime the actual price has changed. To assess the potential impact of such a potential measurement error, recall that we conduct two different types of analysis:

1. We study whether a hotel makes any offers available on certain channels at a certain point in time at all or not (Section 6). For this analysis it is not critical whether Kayak compares exactly the same offers.
2. We compare prices across distribution channels (Section 5). For this analysis it is relevant that we can make a meaningful comparison.

In order to address the concern that the availability and price structure of hotel room offers as displayed at Kayak are measured accurately, we manually conducted a comparison of prices and qualitative features between hotel offers on www.kayak.de with the offers on the websites of the major OTAs. The comparison sample includes 171 booking requests for travel dates ranging from June to August 2016. With regard to the order of prices across channels, we find that the price leader among qualitatively comparable offers is correctly detected by Kayak in more than 90% of all cases. Furthermore, we have not found patterns in the deviations that indicate a favorable treatment of a particular channel by Kayak. For a detailed description of the validation analysis see Annex II. Reassured by our checks, we eventually base our analysis on the assumption that Kayak is comparing equal offers with each other as this is the core of the business model of a price comparison site.

We cannot rule out though that there might still be differences across the offers in some of the cases even though Kayak posts these prices for comparison. Even if there are some differences across the offers, our analyses of the different price changes across countries are still valid as long as these unobserved differences between offers do not change over time in a way that is mistakenly interpreted as a change due to the BPCs. For instance, for the result of the direct channel having the strictly lowest price more often once the BPC is removed to be flawed, it would need to be the case that Kayak in the year 2016 increasingly often wrongly presented the direct channel price as the lowest price, but only for hotels in Germany. We have no indication for this very particular bias of the Kayak search results.

8 Conclusion

Motivated by recent proceedings against best price clauses imposed by online travel agents, we have empirically investigated the effects of such clauses using meta-search price data of nearly 30,000 hotels in various countries from January 2016 to January 2017. We capture the abolition of Booking.com’s narrow BPC in Germany during our observation period, so that we are able to particularly address the competitive effects of narrow BPCs.

We have found that more hotels publish prices at Booking.com in Germany following the removal of the narrow BPC (extensive margin), and hotels which already used Booking.com before publish offers more frequently there (intensive margin). These are Germany-specific trends which distinctively differ from the main developments in the control group. In addition, more independent hotels, which initially often did not make direct channel prices available at Kayak, start doing so more often in Germany once the BPC of Booking.com is removed. Consistent with having posted direct prices more often on Kayak before, chain hotels in Germany increase the frequency of listing direct channel prices once the BPC is removed. These results indicate that hotels increasingly promote the direct channel when they are not constrained by Booking.com’s narrow BPC.

We also find that chain hotels in Germany more frequently set the direct online channel price below all other online prices available at Kayak once the BPCs are removed in Germany. Again, this trend differs from the main developments in the control group. This suggests that Booking.com’s narrow BPC did indeed restrict the hotel’s price setting. We do not observe such a trend for independent hotels, which is consistent with the observation that independent hotels already initially had a direct channel price below the price of Booking.com much more often than chain hotels, indicating a higher non-compliance with BPCs.

More generally, across the different countries and BPC regimes, the observed direct channel prices are below the prices at Booking.com in a significant fraction of the cases. Even when accounting for the possibility that the Kayak data is imprecise to some degree, the numbers suggest that there could be a significant non-compliance with the existing price parity clauses. While the degree of non-compliance appears to be rather similar across the different European countries with narrow BPCs and without BPCs, it appears to be sig-

nificantly lower in Canada – the only country in our data set where the major OTAs still use wide BPCs. This could be interpreted as an indication that the original wide BPCs are more effective in disciplining the price setting of hotels than the narrow clauses. To see this note that the narrow BPCs of Booking.com in Europe (and indirectly of Expedia which aligned its clauses) are the result of commitments that Booking.com gave to the competition authorities of France, Italy and Sweden. These commitments include certain clauses that prevent Booking.com from enforcing compliance with the narrow BPCs.⁴⁶ Moreover, the prominent policy actions against the OTAs might have discouraged OTAs in Europe to actually enforce the clauses and similarly might have encouraged part of the hoteliers to not comply.

As prohibitions of BPCs generally aim at enhancing OTA competition, one would expect to observe changes in the commission rates that hotels have to pay for every mediated booking. Yet, to our knowledge, the standard commission rates of the major OTAs have not changed since the competition policy interventions in Europe.⁴⁷ One reason could be that the effects of BPCs are limited overall. To the extent that hotels did not comply the parity clauses or that the clauses were not binding because hotels charged higher direct prices than OTA prices, it is natural that their abolition had limited effects. Another reason for why the standard commission rates have not yet changed could be that the large OTAs can sustain such commission rates nowadays also without parity clauses. For instance, the OTAs might have incentives to not create evidence in the sense that commission rates decrease in countries without parity clauses in view of the ongoing evaluation of the sector by competition authorities.

We see scope for more empirical research with respect to best price clauses of online travel agents. Future empirical research should assess the long term effects and welfare implications of BPCs, including the level of consumer prices as well as possible changes in the effective commission rates of online travel agents.

⁴⁶Such measures could include e.g. de-listing of non-compliant hotels. See Section 4 of the Booking.com commitments (last accessed December 1, 2017; http://www.konkurrensverket.se/globalassets/english/news/13_596_bookingdotcom-commitment.pdf).

⁴⁷See Annex III for details.

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Annex I: Countries and cities covered in data set

Tables 9 until 13 show the selected countries and cities covered in our data set. Data collection started for the 25 biggest German cities (Table 10) and a control sample of 20 pairs of German and non-German cities along the German border (Table 11) in January 2016. In order to cover all three different BPC regimes in the data and to gather data for countries in which future decisions on BPC are possible, the additional countries depicted in Table 9 were subsequently included. For these countries, we chose a composition of the fifteen biggest cities and fifteen largest travel destinations with the objective to gather representative data across touristic and urban destinations for these countries.

Table 9: Countries covered in data set

Country	Cities covered	Start
Germany	25 biggest cities	25/01/2016
Various	20 pairs of cities near German border	27/01/2016
Italy	15 biggest cities and 15 tourist destinations	10/02/2016
Sweden	15 biggest cities and 14 tourist destinations	12/02/2016
Canada	15 biggest cities and 15 tourist destinations	12/02/2016
France	15 biggest cities and 15 tourist destinations	18/02/2016
Austria	15 biggest cities and 15 tourist destinations	20/04/2016

Table 10: Germany - TOP 25 cities

Germany TOP 25 cities				
Berlin	Stuttgart	Leipzig	Bochum	Karlsruhe
Hamburg	Dusseldorf	Dresden	Wuppertal	Mannheim
Munich	Dortmund	Hanover	Bielefeld	Augsburg
Cologne	Essen	Nuremberg	Bonn	Wiesbaden
Frankfurt am Main	Bremen	Duisburg	Munster	Gelsenkirchen

Table 11: Twin cities along German border

Pair	German City	Non-German neighbor	Country of neighbor
1	Flensburg	Kolding	Denmark
2	Puttgarden/Fehmarn	Rodby	Denmark
3	Wilhelmshaven	Groningen	The Netherlands
4	Borkum	Schiermonnikoog	The Netherlands
5	Rheine	Enschede	The Netherlands
6	Aachen	Maastricht	The Netherlands
7	Heringsdorf	Wolin	Poland
8	Greifswald	Stettin	Poland
9	Cottbus	Zielona-Gora	Poland
10	Trier	Rosport	Luxembourg
11	Monschau	Eupen	Belgium
12	Pruem	St. Vith	Belgium
13	Saarbrücken	Metz	France
14	Karlsruhe	Strasbourg	France
15	Freiburg	Basel	Switzerland
16	Konstanz	St. Gallen	Switzerland
17	Oberstdorf	Bad Ischl	Austria
18	Garmisch-Partenkirchen	Innsbruck	Austria
19	Nuremberg	Pilsen	Czech Republic
20	Dresden	Prague	Czech Republic

Table 12: Cities covered in data set

Italy	Canada	France	Sweden	Austria
<i>Biggest Cities</i>				
Rome	Toronto	Paris	Stockholm	Vienna
Milan	Montreal	Marseille	Göteborg	Graz
Naples	Vancouver	Lyon	Malmö	Linz
Turin	Calgary	Toulouse	Uppsala	Salzburg
Palermo	Edmonton	Nice	Västerås	Innsbruck
Genoa	Ottawa	Nantes	Örebro	Klagenfurt
Bologna	Québec	Strasbourg	Linköping	Villach
Florence	Winnipeg	Montpellier	Helsingborg	Wels
Bari	Hamilton	Bordeaux	Jönköping	St. Pölten
Catania	Kitchener	Lille	Norrköping	Dornbirn
Venice	London	Rennes	Lund	Wiener Neustadt
Verona	Victoria	Reims	Umeå	Steyr
Messina	Saint Catharines	Le Havre	Gävle	Feldkirch
Padua	Halifax	Saint-Étienne	Boras	Bregenz
Trieste	Oshawa	Toulon	Eskilstuna	Leonding
<i>Tourist Destinations</i>				
Lecce	Regina	Grenoble	Växjö	Zell am See
Viareggio	St. John's	Cannes	Luleå	Kitzbühel
Matera	Fredericton	Chambéry	Falun	Bad Hofgastein
Sanremo	Charlotte Town	Annecy	Varberg	Hermagor
Mantova	Whitehorse	Aix-les-Bains	Visby	Schladming
Vasto	Yellowknife	Menton	Ystad	Mittelberg
Merano	Niagara On The Lake	Albertville	Kiruna	Neustift
Caltagirone	Whistler	Bayeux	Strömstad	Bad Gastein
Montecatini	Banff	Argelès-sur-Mer	Ronneby	Velden am Wörther See
Terme				
Narni	Jasper	Chamonix	Jokkmokk	Finkenstein am Faaker See
Abano Terme	Tofino	Évian-les-Bains	Grebbestad	Kirchberg in Tirol
Ischia	Dawson City	Cavalaire-sur-Mer	Marstrand	St. Kanzian
Monte Argentario	Churchill	Saint-Gervais-les-Bains	Jukkasjärvi	Mayrhofen
San Felice Circeo	Bay of Fundy	Gruissan	Stöllet	Seefeld in Tirol
Santa Margherita	Thousand Islands	Sainte-Marine		Sölden
Ligure	National Park			

Selection of travel destinations

For Italy, Sweden, Canada, France and Austria we selected the travel destinations in two steps. First, we looked up the fifteen biggest cities in terms of population on Wikipedia respectively. Additionally, for each country, we collected information about popular tourist destinations from travel guides and official tourism websites. We then ordered all these destinations by population and took again the fifteen biggest locations. For Italy, France,

Sweden and Canada the websites were all accessed in January and February 2016. The Austrian cities were selected in April 2016 after the Austrian competition authority announced to proceed against the narrow BPC later in 2016.

The sources of the travel destinations can be found in Table 13.

Table 13: Sources for travel destination selection

Country	Type	Source
<i>Italy</i>	Listing of health resorts	wikipedia.de
	Ten most popular beaches	telegraph.co.uk
	Beyond Rome and Florence: 12 alternative Italian destinations	cnn.com
<i>Sweden</i>	Top 10 Places in Sweden	neverstoptraveling.com
	Top 10 Green Attractions	visitsweden.com
<i>Canada</i>	Travelers Choice	tripadvisor.com
	Tourist attractions	planetware.com
	Places to Go	de-keepexploring.canada.travel
<i>France</i>	The top 10 beach holidays	telegraph.co.uk
	Travelers Choice Destinations	tripadvisor.com
	16 Top-Rated Tourist Attractions in the French Alps	planetware.com
<i>Austria</i>	Most popular winter destinations	austriatourism.at
	Most popular summer destinations	austriatourism.at

Annex II: Validation of Kayak data

Kayak’s business model aims at comparing hotel room offers of different distribution channels. We understand that Kayak derives revenue from referring customers to the websites of OTAs or other booking providers. As such it should seek to offer customers a convenient and reliable comparison facility. In order to facilitate the comparison of hotel offers, Kayak collects general information on room types, bed types and booking conditions from the different distribution channels and displays them to the customer when clicking on the detailed overview for one particular hotel. As mentioned in Section 3.1, in order to validate the accuracy of the offers listed on Kayak, we have compared prices and qualitative features of 171 hotels on Kayak with corresponding offers on the websites of the major OTAs and the hotel websites.

We generated our validation sample as follows. From all hotels that we observed in our

data we took a random draw of 115 hotels. We augmented the sample with 56 hotels from Germany, Austria and Sweden that we observed to frequently offer a direct sales channel on Kayak. We did this to obtain more observations with direct channel prices as well as HRS prices and to have a better coverage of the countries Germany, Austria and Sweden. Consequently, the sample consists of observations from Canada, Italy, Sweden, Germany, Austria and France plus a few observations for the Czech Republic, Switzerland and Poland. For 40 hotels of our sample Kayak did not display any information during the enquiry period for various travel dates.

From the overview page for a particular hotel on Kayak, we obtain room rates for all available sales channels and information on room features (e.g. double bed) and booking conditions (e.g. free cancellation, free breakfast, etc.). In cases where Kayak displayed several offers for one single distribution channel (e.g. if Kayak displays the offers for a two-bed room and for a three-bed room on Expedia), we focus the analysis on the offer with the same qualitative features as on the other distribution channels. We used the forwarding links on the Kayak website to reach the corresponding offer on the OTAs and the hotel websites.

With the gathered data we conducted two kinds of consistency validations. First, we compare prices and qualitative characteristics of a room offer on Kayak with the corresponding offer on the OTAs or on the hotel website. Second, we verify whether the price structure between the major OTAs and the direct sales channel shown on Kayak is consistent with the price structure on OTAs and hotel websites. In eight cases (9% of all observations with at least two distribution channels on Kayak) the qualitative features as displayed on Kayak differed across the distribution channels.⁴⁸ As prices are not comparable across channels in these cases, the observations are excluded from the analysis of the price structure.

As shown in Table 14 we observe that prices coincide in more than two-thirds of all observations on both sources. For this comparison, we have assumed that prices coincide if the difference amounts to less than three EUR in order to capture differences in rounding and exchange rates.⁴⁹ For deviating prices, the data suggest that prices on Kayak most

⁴⁸Deviations are due to different cancellation policies or the inclusion of breakfast and do not seem to affect room offers or sales channels systematically.

⁴⁹Expedia displays an exact amount including euros and cents for a hotel room, while Booking.com

often are higher than the prices on OTAs and websites and that only in a few cases prices on Kayak are lower than on the actual sales channel. The sales channel that is measured most accurately is the direct sales channel. On average, prices on Kayak and prices on the OTAs or the hotel websites deviate from each other by approximately five EUR. Comparing the room features and booking conditions on both sources, we found that this information on Kayak is identical with the information provided on the OTA or the hotel website, whenever rooms were available on both sources.

Table 14: Frequency of price deviations of Kayak from OTAs and hotel websites

	N	Kayak price higher	Kayak price equal	Kayak price lower
Booking.com	106	26%	69%	5%
Expedia	64	34%	66%	0%
HRS	34	29%	68%	3%
Direct channel	51	12%	80%	8%

In order to ensure comparability among sales channels in the second consistency validation, we only compared hotel offers of different sales channels with each other if these offers were qualitatively identical. In more than 90% the offers find qualitatively comparable room offers regarding room features and booking conditions on the distribution channels. Among these offers we identify a price leadership whenever the lowest price is at least 1 EUR lower than the second lowest price. Table 15 shows that the information whether one sales channel is the price leader (i.e. offers a price strictly lower than the second best and qualitatively identical offer) is consistent between Kayak and the actual sales channels in approximately 90% of the cases. If there is a distinct price leader the average difference between the lowest price and the second lowest price is around 7.50 EUR both on Kayak and on the sales channels.

Table 15: Consistency of price leadership

Price leadership	N	Price leadership consistent
Booking.com	67	93%
Expedia	50	91%
HRS	29	91%
Direct channel	39	89%

usually adjusts prices upwards to the next integer. Moreover, prices from Sweden or Canada sometimes were displayed in domestic currencies. For the sake of comparability, we converted the prices in EUR using the exchange rate of the booking date (Source: www.finanzen.net/waehrungsrechner/).

Annex III: Evidence on commission rates of OTAs

We understand that major OTAs such as Booking.com and Expedia use an agency model where hotels set room prices on the OTA and pay a commission to the OTA for every realized booking via the OTA. We understand that effective commissions are determined by a standard rate plus an additional fee if hotels want to appear higher in the OTA's ranking.⁵⁰ The interventions against BPCs aimed at removing restraints of competition among OTAs in commission rates. However, the recent interventions have not obviously led to significant changes in the OTAs' commission rates so far. A recent Europe-wide survey by HOTREC finds that for more than 90% of all hotels the effective commission rates have not decreased over the past one year.⁵¹ Our anecdotal examination (including interviews with hoteliers) in the course of 2016 indicates that basis commission rates of the major OTAs range between 12% and 18% in Europe. While we took note of basis commissions of 15% at Expedia and HRS, Booking.com's basis commissions apparently vary across destinations (see Table 16 for the observations). Similarly, the Bundeskartellamt reported in the decisions regarding HRS⁵² and Booking.com⁵³ that in 2013 and in 2015 the major OTAs' basis commission rates range from 10% to 15%. This also indicates that in Germany (basis) commissions have not changed in the last years.

Table 16: Booking.com's standard commissions by destination

Dusseldorf	Berlin	Termoli	Rome	Orebro	Stockholm	Toulouse	Paris
12%	15%	15%	18%	15%	15%	17%	15%

According to the Bundeskartellamt, effective commissions can account for up to 50% of the room price.⁵⁴ In 2015, the German hotel association estimated average commissions payments to range between 20% and 25%.⁵⁵

⁵⁰For example via Expedia's hotel accelerator program that sells higher ranking positions by auction (see <https://skift.com/2016/03/03/first-look-at-expedias-hotel-accelerator-program-for-improving-hotel-placement/>; last accessed December 1, 2017) or Booking.com's preferred partner program (see <http://www.booking.com/content/hotel-help.de.html>; last accessed December 1, 2017).

⁵¹HOTREC survey on online platforms of 2016 (see <http://www.hotrec.eu/newsroom/press-releases-1714/dominant-online-platforms-gaining-market-share-in-travel-trade-no-signs-of-increased-competition-between-online-travel-agents-unveils-european-hotel-distribution-study.aspx>; last accessed December 1, 2017).

⁵²Bundeskartellamt (2013) B9-66-10 Par. 225

⁵³Bundeskartellamt (2015) B9-121-13 Par. 18.

⁵⁴Bundeskartellamt (2015) B9-121-13 Par. 2.

⁵⁵Statement of the German hotel association from August 31, 2015 according to Bundeskartellamt (2015) B9-121-13, Fn 414.

Annex IV: Public decisions with respect to BPCs of OTAs in Europe

Table 17: List of public decisions with respect to BPCs

Date	Country	Decision body	Content	Reference
01/2014	UK	OFT	OFT decision	Decision 31.01.2014, OFT1514dec – Case reference CE/9320/10
12/2013	Germany	Bundeskartellamt	Prohibition	Decision of 20.12.2013, B 9 – 66/10 – HRS - Hotel Reservation Service
04/2015	Sweden	Konkurrensverket	Acceptance of Booking.com's commitment to at most narrow BPCs with effect of July 2015	Decision of 15.04.2015 – 596/2013 – Booking.com
“	France	Autorité de la concurrence	“	Decision of 21.04.2015 – 15-D-06 – Booking.com
“	Italy	Autorità Garante della Concorrenza e del Mercato	“	Decision of 21.04.2015 – I779 – Booking.com
2015	UK	Court decision	OFT decision was annulled on appeal on procedural grounds	CMA press release, 16.09.2015, CMA closes hotel online booking investigation. ^a
07/2015	EU/EEA	Expedia	Announces to use narrow BPCs in Europe	Expedia press release 01.07.2015; „Expedia Amends Rate, Conditions and Availability Parity Clauses“. ^b
07/2015	France	French parliament	Law that prohibits BPCs for OTAs in France	„Loi Macron“ 10.07.2015. ^c
12/2015	Germany	Bundeskartellamt	Prohibitions of Booking.com's narrow BPCs by February 2016. Announcement to continue investigation with Expedia	Bundeskartellamt, decision of 23.12.2015, B 9-121/13 – Booking.com.
07/2016	Austria	Austrian parliament	Government bill to prohibit narrow BPCs for OTAs in Austria by January 2017	Nationalrat, decision of 18.10.2016 government bill (1251 d.B.)
11/2016	France	Tribunal de commerce de Paris	Prohibitions of availability parity clauses	Decision of 29.11.2016 - No. RG: 2014027403 - Booking.com

^aSee <https://www.gov.uk/government/news/cma-closes-hotel-online-booking-investigation>, last accessed December 1, 2017

^bSee <http://www.expediainc.com/news-release/?aid=123242&fid=99&yy=2015>, last accessed December 1, 2017

^cSee <http://www.hotelnewsnow.com/Article/16460/Frances-end-to-rate-parity-creates-grey-areas>, last accessed December 1, 2017

Annex V: Definition of OTAs and direct sales channels

In our data set, we observe 76 distinct sales channels that list hotel rooms on Kayak. These can be classified into OTAs like Booking.com, and the direct hotel channel. Taking together all hotel offers out of all Kayak requests, we observe in total more than 108 million price offers. Table 18 lists the 15 most observed sales channels that account for almost 90% of all observed price offers. Booking.com is the most frequent channel in our data set accounting for 17% of all price observations.

Table 18: Sales channels observed on Kayak

Sales Channel	No.	%
BOOKINGDOTCOM	18,534,188	17.1
HOTELSDOTCOM	16,235,725	15.0
EXPEDIAHOTEL	16,208,094	15.0
EBOOKERSHOTEL	11,156,665	10.3
AGODA	5,420,055	5.0
HRS	5,338,770	4.9
HOTELRESERVIERUNG	4,350,524	4.0
HOTELOPIA	3,935,577	3.6
AMOMA	3,659,841	3.4
TRIPADVISOR	2,674,348	2.5
HOTELSCCLICK	2,338,775	2.2
OTEL	2,003,584	1.8
LOWCOSTHOLIDAYS	1,361,933	1.3
TOURICO	1,310,164	1.2
VENERE	1,093,568	1.0
Total	108,411,643	100.0

It is noteworthy that the well-known OTAs Booking.com, Expedia and HRS belong to company groups which own further OTAs (Table 21). Together the three company groups account for more than two-thirds of our price observations. For these Kayak requests in which two OTAs of the same company group are observed together (column 4), we computed how often the prices are identical (column 5).

As a benchmark, we also compared the primary OTAs Booking.com, Expedia and HRS in Tables 19 and 20. Table 19 shows how frequently the OTAs appear together in one Kayak request. For those Kayak requests in which two OTAs are observed together, we find that prices are equal in less than 50% (Table 20).

Table 19: Contingency of OTA Listings

	Booking.com	Expedia	HRS
Booking.com	18,534,188		
Expedia	13,792,646	16,208,094	
HRS	4,669,818	4,305,990	5,338,770

Table 20: Price coherence on major OTAs

	Booking.com	Expedia	HRS
Booking.com	100%		
Expedia	42%	100%	
HRS	52%	46%	100%

We conducted the same analysis with OTAs belonging to the same company group. The OTA Agoda that belongs to the Priceline Group appears in more than 80% with the primary website Booking.com. For the OTAs belonging to Expedia Inc. (Hotels.com, Venere, ebookers) the mutual appearance with the primary website Expedia is at almost 100% of all observations. The Expedia website prices are also very often equal to the prices at Hotels.com and Venere,⁵⁶ which suggests to treat them as one entity. For ebookers an abrupt change in pricing policy can be observed between May and June 2016. While ebookers used to have a price parity with Expedia in only 18% of all Kayak requests until May, this value increased in June and July to 90%. Therefore, also Expedia and ebookers is treated as one entity.

Interestingly, the correspondence between Booking.com and Agoda is quite low. As a consequence, we treat them as separate OTAs. Finally, we also treat HRS and Hotel.de as separate as the mutual appearance between HRS and Hotel.de is at only 39% and also the coherence is only moderate.

⁵⁶Note that the OTA Venere is observed on Kayak only in January and February 2016.

Table 21: Price coherence within company groups

Group	OTA	Share in total price listings	Appearance with primary website	Price coherence with primary website
Priceline	Booking.com	17%	100%	100%
	Agoda	5%	87%	38%
Expedia Inc.	Expedia	15%	100%	100%
	Hotels.com	15%	98%	90%
	Venere	1%	98%	98%
	ebookers	10%	98%	75%
HRS Robert Rague GmbH	HRS	5%	100%	100%
	Hotel.de	1%	39%	71%

Annex VI: Robustness check: Increase of Booking.com’s listing frequency in Germany

The Booking.com price publication frequency in Germany starts from a considerably lower level than the frequencies in the other countries at the beginning of the observation period in 2016 (Figure 2). One might, therefore, wonder whether the increase in the publication frequencies of Booking.com in Germany can be fully attributed to the prohibition of its narrow BPC by the Bundeskartellamt.

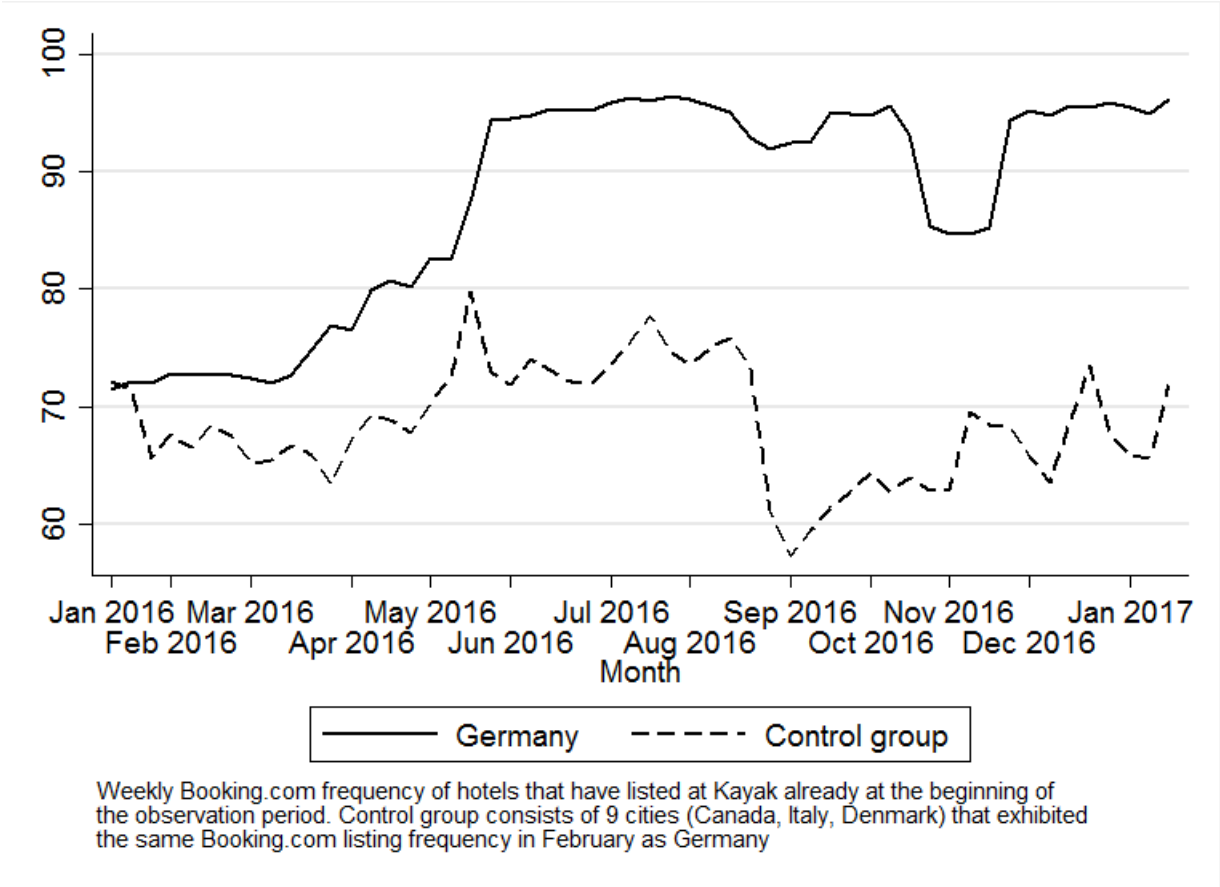
An alternative hypothesis could be that Booking.com might undergo a general catch-up process in regions where it is less established. To descriptively verify the robustness of our result, we conducted a comparison between the evolvement of Booking.com’s listing frequency in Germany and in a control group. The control group consists of nine non-German cities that, on average, exhibit the same Booking.com listing frequency as it can be observed in Germany at the beginning of 2016. The cities of the control group were selected as follows:

At the city-level, we computed for every month the average Booking.com frequency. Taking the nine non-German cities with the lowest Booking.com frequency in February yields approximately the same average Booking.com frequency as for Germany as a whole (74.5%, while 72.6% in Germany). These cities are Rome, Venice, Ischia (all Italy), Rodby (Denmark), Dawson City, Yellowknife, Gananoque (Ottawa), Tofino, St. Catharines (all

Canada). Figure 5 shows how weekly Booking.com frequencies evolve over time for the two groups. In Germany the frequency increases sharply from 73% in February to 96% in June and July and remains at the same level for most of the remaining observation period. The listing frequency of the control sample has the same frequency level at the beginning of the year. But in contrast to Germany, the Booking.com frequency of the control sample does not show a similar increase and only fluctuates between 59% and 80% during the whole observation period.

Hence, we conclude from the comparison of Germany with a control sample consisting of nine cities from Europe and Canada that there is no general catch-up process in regions with low Booking.com frequencies that drives the development in Germany. In turn, this result is taken as supporting evidence that the abolition of Booking.com’s BPCs in Germany can be contributed to the especially sharp increase of Booking.com listings in Germany.

Figure 5: Booking.com Frequency (Germany and control group)



A related regression on the intensive channel use of the direct channel and Booking.com with the control sample reveals the same result as in the descriptive representation. The intensive channel use of Booking.com increases significantly while the significant and negative trend deviations for the other countries show that the trend in the control sample is in total approximately zero.

Table 23: Intensive channel use

	(1)	(2)
	Direct	Booking.com
Trend (Base: Germany)	0.19*** (0.03)	2.32*** (0.08)
Δ Trend Italy	-0.17*** (0.04)	-2.37*** (0.14)
Δ Trend Canada	-0.06 (0.19)	-1.99*** (0.38)
Δ Trend Denmark	-0.72*** (0.10)	-4.08*** (0.17)
Share of non-listed hotels	-0.08*** (0.00)	-0.23*** (0.01)
Kayak hotel rating	0.08 (0.34)	2.49** (1.27)
GT city	-0.01*** (0.00)	-0.04*** (0.01)
GT Booking.com	-0.00 (0.00)	0.25*** (0.01)
7 days before	0.05 (0.03)	-0.13 (0.08)
14 days before	0.08** (0.03)	0.04 (0.09)
21 days before	0.11*** (0.04)	0.25** (0.10)
28 days before	0.13*** (0.04)	0.50*** (0.11)
Weekdays	Yes	Yes
Popularity other OTAs	Yes	Yes
Hotel FE	Yes	Yes
Observations	6,515,918	6,515,918
R^2	0.880	0.404
Adjusted R^2	0.880	0.404

Standard errors (clustered by hotel) in parentheses. Dependent variables are equal to 100 if particular channel is present at Kayak request and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Annex VII: Robustness check: Split samples and hotel characteristics

We test the robustness of our main regression results concerning three variations to the main specification (Table 24 until Table 29). Column 1 reports the main specification as in Sections 5 and 6 for comparison. In general, we find that our results are robust with respect to different specifications.

In column 2, we restrict the observation period to the time frame between January 2016 and July 2016. Recall from Figure 2 that we observe a strong adaption process of the Booking.com listing frequency shortly after the removal of the narrow BPC. In line with this observation, the regression coefficients for the German-specific trend for our main dependent variables of interest are larger in magnitude than the coefficients for the main regression which takes data until January 2017 into account.

There is a share of hotels that exhibit no variation in the dependent variables during the observation period. Therefore we seek in column 3 to identify the fraction of hotels that indeed react to the removal of Booking.com’s narrow BPC in Germany by changing their listing or pricing *strategy*.⁵⁷ To do so, we drop all observations from hotels that do not change their strategy during the observation period. By definition, these hotels exhibit a zero time trend and we find that coefficients are larger in magnitude than those in the main regressions.

Finally, in column 4, we report the main regression without hotel fixed effects. In turn, we are able to include the time-invariant observed hotel characteristics, like the number of rooms and the stars.⁵⁸ Even though the significance level and the sign of the coefficients generally coincide with the main regression, we find differences in the magnitude of the coefficients. This finding reassures us that we are able to capture unobserved heterogeneity by employing hotel fixed effects.

⁵⁷For the regressions on the Kayak request level (intensive channel use and price leadership) the share of hotels that does not change their *strategy* ranges between 0.1% (direct channel as price leader) and 12% (Booking.com as distribution channel). For the regressions on the extensive channel use these figures are considerably higher as the unit of observation is on the hotel-month level. Accordingly, all hotels that use, for example, Booking.com at least once every month, in which we observe them, exhibit no variation in the dependent variable “Extensive Booking.com use”. Only 5% (Booking.com) and 18% (direct channel) of all hotel-month observations exhibit variation in this respect.

⁵⁸The time-invariant characteristics are centered (cent) around the mean.

Table 24: Robustness check - Price leadership of direct channel

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	0.30*** (0.09)	1.47*** (0.18)	0.30*** (0.09)	0.33*** (0.10)
Δ Trend France	-0.69*** (0.12)	-1.11*** (0.23)	-0.70*** (0.12)	-0.76*** (0.13)
Δ Trend Italy	-0.35** (0.17)	-0.88*** (0.29)	-0.35** (0.17)	-0.53*** (0.19)
Δ Trend Sweden	-1.66*** (0.29)	-2.59*** (0.42)	-1.66*** (0.29)	-1.62*** (0.27)
Δ Trend Austria	-0.34 (0.22)	-0.62 (0.49)	-0.34 (0.22)	-1.25*** (0.32)
Δ Trend Canada	-0.20* (0.11)	-0.98*** (0.21)	-0.20* (0.11)	-0.39*** (0.12)
Δ Trend Other countries	-0.50*** (0.18)	-0.73** (0.34)	-0.50*** (0.18)	-0.70*** (0.22)
Share of non-listed hotels	0.02** (0.01)	0.02*** (0.01)	0.02** (0.01)	0.10*** (0.02)
Kayak hotel rating (centered)	0.40 (1.01)	-0.63 (1.30)	0.37 (1.01)	3.80*** (0.58)
GT city	0.03*** (0.01)	0.02* (0.01)	0.03*** (0.01)	0.01 (0.02)
GT Booking.com	0.01 (0.01)	-0.06*** (0.01)	0.01 (0.01)	-0.00 (0.01)
France				7.88*** (1.44)
Italy				-0.47 (1.82)
Sweden				11.84*** (2.73)
Austria				10.16*** (3.31)
Canada				-0.50 (1.21)
Other countries				3.00 (2.52)
Hotel category in stars (centered)				-0.93* (0.53)
Number of rooms (centered)				-0.03*** (0.00)
Constant				6.47*** (2.46)
Weekdays	Yes	Yes	Yes	Yes
Days before travel date	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	2,968,019	1,792,366	2,964,607	2,921,753
R^2	0.426	0.461	0.426	0.028
Adjusted R^2	0.425	0.460	0.425	0.028

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for all observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 if direct channel is price leader and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 25: Robustness check - Price leadership of Booking.com

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	-0.14*** (0.04)	-0.35*** (0.07)	-0.14*** (0.04)	-0.21*** (0.04)
Δ Trend France	0.22*** (0.06)	0.30*** (0.11)	0.22*** (0.06)	0.16*** (0.06)
Δ Trend Italy	0.27*** (0.07)	-0.29** (0.13)	0.27*** (0.07)	0.33*** (0.08)
Δ Trend Sweden	0.07 (0.11)	-1.10*** (0.27)	0.07 (0.11)	-0.01 (0.13)
Δ Trend Austria	-0.28*** (0.10)	-0.79*** (0.28)	-0.28*** (0.10)	-0.22 (0.15)
Δ Trend Canada	0.09 (0.08)	-0.11 (0.14)	0.08 (0.08)	0.18** (0.08)
Δ Trend Other countries	0.40*** (0.12)	-0.12 (0.20)	0.40*** (0.12)	0.19 (0.16)
Share of non-listed hotels	-0.02** (0.01)	-0.00 (0.01)	-0.01** (0.01)	-0.07*** (0.01)
Kayak hotel rating (centered)	2.20*** (0.82)	2.44** (1.04)	2.17*** (0.82)	0.43 (0.27)
GT city	0.02*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	-0.04*** (0.01)
GT Booking.com	0.16*** (0.01)	0.17*** (0.01)	0.16*** (0.01)	0.18*** (0.01)
France				3.61*** (0.63)
Italy				2.78*** (0.66)
Sweden				4.27*** (1.15)
Austria				7.30*** (1.60)
Canada				5.78*** (0.68)
Other countries				3.80*** (1.26)
Hotel category in stars (centered)				-0.88*** (0.21)
Number of rooms (centered)				-0.01*** (0.00)
Constant				3.12*** (1.19)
Weekdays	Yes	Yes	Yes	Yes
Days before travel date	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	2,904,221	1,762,803	2,889,402	2,857,448
R^2	0.147	0.165	0.144	0.022
Adjusted R^2	0.146	0.164	0.143	0.022

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for all observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 if Booking.com is price leader and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 26: Robustness check - Extensive direct channel use

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	0.06*** (0.02)	0.23*** (0.04)	1.50*** (0.54)	0.45*** (0.05)
Δ Trend France	0.05 (0.04)	-0.16** (0.07)	-0.20 (0.65)	-0.05 (0.05)
Δ Trend Italy	-0.12*** (0.03)	-0.35*** (0.06)	-3.04*** (0.71)	-0.27*** (0.03)
Δ Trend Sweden	-0.10 (0.06)	-0.33*** (0.09)	-2.83 (1.88)	-0.32*** (0.08)
Δ Trend Austria	-0.02 (0.06)	0.66*** (0.16)	-0.94 (0.92)	-0.15* (0.09)
Δ Trend Canada	-0.08* (0.04)	-0.16* (0.09)	-1.77* (1.07)	-0.13* (0.07)
Δ Trend Other countries	-0.01 (0.05)	-0.20** (0.08)	-0.07 (1.26)	-0.13** (0.06)
Avg. share of non-listed hotels	-0.00 (0.00)	0.00 (0.01)	-0.13 (0.13)	-0.08*** (0.02)
Avg. Kayak hotel rating (centered)	0.36 (0.24)	0.38 (0.30)	9.37 (7.07)	-0.20 (0.23)
Avg. GT city	0.00 (0.00)	-0.00 (0.00)	0.04 (0.06)	0.11*** (0.01)
Avg. GT Booking.com	-0.00* (0.00)	-0.01** (0.01)	-0.08 (0.05)	-0.08*** (0.01)
France				13.77*** (0.80)
Italy				1.25** (0.61)
Sweden				2.55 (1.74)
Austria				4.25*** (1.07)
Canada				19.32*** (1.20)
Other countries				-0.07 (1.09)
Hotel category in stars (centered)				5.16*** (0.33)
Number of rooms (centered)				0.16*** (0.01)
Constant				8.76*** (2.42)
Weekdays	No	No	No	No
Days before travel date	No	No	No	No
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	283,389	150,446	13,443	272,856
R^2	0.946	0.958	0.379	0.203
Adjusted R^2	0.940	0.949	0.319	0.203

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for all observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 for all months in which a hotel used the direct channel at least once and 0 otherwise. * $p \leq 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 27: Robustness check - Extensive Booking.com use

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	1.80*** (0.06)	4.16*** (0.13)	7.20*** (0.16)	1.61*** (0.05)
Δ Trend France	-0.92*** (0.07)	-1.87*** (0.16)	-1.74*** (0.23)	-0.84*** (0.07)
Δ Trend Italy	-0.21*** (0.07)	0.13 (0.17)	-0.79*** (0.20)	-0.19*** (0.07)
Δ Trend Sweden	-1.97*** (0.07)	-3.50*** (0.13)	-8.53*** (0.91)	-1.87*** (0.07)
Δ Trend Austria	-1.08*** (0.08)	-1.97*** (0.24)	-1.83*** (0.42)	-0.97*** (0.09)
Δ Trend Canada	-1.82*** (0.06)	-3.30*** (0.13)	-7.23*** (0.52)	-1.69*** (0.07)
Δ Trend Other countries	-1.80*** (0.06)	-3.55*** (0.14)	-6.59*** (0.46)	-1.70*** (0.06)
Avg. share of non-listed hotels	-0.11*** (0.01)	-0.26*** (0.02)	-0.94*** (0.07)	-0.07*** (0.01)
Avg. Kayak hotel rating (centered)	1.57*** (0.50)	1.96** (0.81)	4.94*** (1.70)	1.69*** (0.15)
Avg. GT city	-0.03*** (0.00)	0.00 (0.01)	-0.03* (0.02)	-0.05*** (0.00)
Avg. GT Booking.com	0.14*** (0.00)	-0.08*** (0.01)	0.97*** (0.02)	0.18*** (0.00)
France				12.39*** (0.69)
Italy				3.26*** (0.65)
Sweden				24.36*** (0.78)
Austria				16.13*** (0.86)
Canada				18.00*** (0.69)
Other countries				21.37*** (0.62)
Hotel category in stars (centered)				-0.24* (0.13)
Number of rooms (centered)				0.00 (0.00)
Constant				60.82*** (1.52)
Weekdays	No	No	No	No
Days before travel date	No	No	No	No
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	283,389	150,446	51,082	272,856
R^2	0.516	0.631	0.405	0.057
Adjusted R^2	0.462	0.550	0.345	0.057

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for all observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 for all months in which a hotel used Booking.com at least once and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 28: Robustness check - Intensive direct channel use

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	0.36*** (0.10)	0.54*** (0.18)	0.36*** (0.10)	0.20* (0.11)
Δ Trend France	-0.59*** (0.12)	-2.30*** (0.24)	-0.59*** (0.12)	-0.26** (0.13)
Δ Trend Italy	-1.33*** (0.20)	-3.77*** (0.45)	-1.34*** (0.20)	-1.11*** (0.21)
Δ Trend Sweden	-0.65*** (0.24)	-1.45*** (0.32)	-0.65*** (0.24)	-0.55** (0.26)
Δ Trend Austria	-0.15 (0.28)	0.09 (0.72)	-0.15 (0.28)	0.62* (0.38)
Δ Trend Canada	-0.32** (0.12)	-1.28*** (0.24)	-0.32** (0.12)	-0.27* (0.14)
Δ Trend Other countries	-0.92*** (0.26)	-2.83*** (0.53)	-0.92*** (0.26)	-1.01*** (0.33)
Share of non-listed hotels	-0.31*** (0.01)	-0.31*** (0.01)	-0.32*** (0.01)	-0.17*** (0.02)
Kayak hotel rating (centered)	-1.14 (1.24)	0.89 (1.39)	-1.13 (1.25)	1.69*** (0.63)
GT city	-0.09*** (0.01)	-0.07*** (0.01)	-0.09*** (0.01)	-0.07*** (0.02)
GT Booking.com	-0.06*** (0.01)	0.03*** (0.01)	-0.06*** (0.01)	-0.07*** (0.01)
France				4.10*** (0.89)
Italy				-0.81 (1.22)
Sweden				2.58* (1.43)
Austria				-10.68*** (3.16)
Canada				4.89*** (0.84)
Other countries				0.91 (1.57)
Hotel category in stars (centered)				-0.13 (0.48)
Number of rooms (centered)				0.02*** (0.00)
Constant				99.85*** (2.00)
Weekdays	Yes	Yes	Yes	Yes
Days before travel date	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	3,723,221	2,270,745	3,715,121	3,651,769
R^2	0.403	0.326	0.402	0.039
Adjusted R^2	0.402	0.325	0.402	0.039

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for all observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 if direct channel is present at Kayak request and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 29: Robustness check - Intensive Booking.com use

	(1) Main reg.	(2) Until July	(3) Strategy	(4) No FE
Trend (Base: Germany)	0.26*** (0.03)	0.35*** (0.04)	0.31*** (0.03)	0.11*** (0.03)
Δ Trend France	-0.24*** (0.04)	-0.37*** (0.06)	-0.26*** (0.04)	-0.10** (0.04)
Δ Trend Italy	-0.61*** (0.05)	-1.22*** (0.08)	-0.67*** (0.06)	-0.51*** (0.05)
Δ Trend Sweden	-0.04 (0.05)	-0.88*** (0.08)	-0.04 (0.05)	0.07 (0.05)
Δ Trend Austria	0.26*** (0.07)	-0.59*** (0.15)	0.34*** (0.08)	0.30*** (0.09)
Δ Trend Canada	-0.09** (0.04)	-1.08*** (0.08)	-0.09** (0.05)	0.12*** (0.04)
Δ Trend Other countries	-0.03 (0.04)	-0.85*** (0.07)	-0.05 (0.05)	0.05 (0.04)
Share of non-listed hotels	-0.28*** (0.00)	-0.27*** (0.00)	-0.33*** (0.01)	-0.20*** (0.01)
Kayak hotel rating (centered)	0.39 (0.46)	1.18** (0.60)	0.45 (0.53)	-0.33*** (0.12)
GT city	-0.07*** (0.00)	0.00 (0.00)	-0.08*** (0.00)	-0.09*** (0.00)
GT Booking.com	0.03*** (0.00)	0.08*** (0.00)	0.04*** (0.00)	0.04*** (0.00)
France				2.94*** (0.33)
Italy				0.17 (0.41)
Sweden				-3.68*** (0.41)
Austria				0.24 (0.75)
Canada				-1.33*** (0.35)
Other countries				0.22 (0.36)
Hotel category in stars (centered)				0.78*** (0.12)
Number of rooms (centered)				0.00* (0.00)
Constant				105.73*** (0.58)
Weekdays	Yes	Yes	Yes	Yes
Days before travel date	Yes	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes	No
Observations	16,284,525	10,025,115	14,293,638	15,916,558
R^2	0.207	0.224	0.199	0.033
Adjusted R^2	0.206	0.222	0.198	0.033

Standard errors (clustered by hotel) in parentheses. (1) is the regression from the main analysis aggregated for all hotel types. (2) only contains data until (end of) July 2016. (3) excludes all hotels that exhibit no variation in the dep. variable ("strategy"). (4) includes no hotel fixed effects and controls for observed hotel characteristics that are centered around the mean. The dep. variable is equal to 100 if Booking.com is present at Kayak request and 0 otherwise. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Annex VIII: Robustness check: Accounting for seasonality with two-month indicators

In this robustness check we run our main regressions with two-month indicators instead of a country-specific linear time trend. With this specification that pools independent and chain hotels together, we allow for country-specific seasonality that goes beyond the main specification with the linear time trend. Moreover, we can compare the realizations of the dependent variables between the reference period (January 2016 and February 2016) to the beginning of 2017, which yields a seasonality-corrected measure of our estimates. We use both January and February 2016 as reference period because we only have a limited coverage of January 2016. We compare this with January 2017 as our data set does not cover February 2017. For the countries of comparison we only report the estimation results for January 2017, which allows us to verify that the materialization of the dependent variable at the end of our observation period generally coincides with the predictions of the linear time trend. The results are in Tables 30 and 31. The comparison to the results of the main regressions (which are reported in Tables 6, 7 and 8) verifies that the results are robust to a more flexible specification that allows for country-specific seasonal trends. We conclude that the linear trend is an informative statistic for aggregating the development of the dependent variables in the countries of investigation.

Table 30: Two-month regressions direct channel

	(1) Ext. use	(2) Int. use	(3) Price leader
March April 2016	1.16*** (0.13)	-0.23 (0.65)	1.62*** (0.44)
May June 2016	1.12*** (0.16)	1.37** (0.69)	5.22*** (0.75)
July August 2016	0.99*** (0.21)	1.47* (0.81)	4.91*** (0.79)
September October 2016	1.18*** (0.22)	1.35 (0.85)	4.67*** (0.78)
November December 2016	1.38*** (0.25)	3.53*** (0.90)	2.38*** (0.90)
January 2017	0.83*** (0.27)	2.55*** (0.95)	3.83*** (1.10)
January 2017 × France	0.80* (0.48)	-8.94*** (1.28)	-4.37*** (1.36)
January 2017 × Italy	-1.40*** (0.34)	-15.79*** (2.06)	-3.88** (1.81)
January 2017 × Sweden	-1.34* (0.75)	-6.79** (2.74)	-3.67* (2.04)
January 2017 × Austria	1.43 (1.16)	13.46*** (4.34)	-0.01 (2.55)
January 2017 × Canada	-0.89* (0.50)	-2.43** (1.24)	-4.08*** (1.28)
January 2017 × Other countries	-0.45 (0.56)	-8.85*** (3.00)	-5.20** (2.11)
Avg. share of non-listed hotels	-0.00 (0.00)		
Avg. Kayak hotel rating	0.35 (0.24)		
Avg. GT city	0.01** (0.00)		
Avg. GT Booking.com	-0.00 (0.00)		
Share of non-listed hotels		-0.32*** (0.01)	0.04*** (0.01)
Kayak hotel rating		-1.21 (1.24)	0.47 (1.01)
GT city		-0.05*** (0.01)	0.03*** (0.01)
GT Booking.com		-0.01 (0.01)	0.01* (0.01)
Weekdays	No	Yes	Yes
Days before travel date	No	Yes	Yes
Other two-month-country interactions	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes
Observations	283,389	3,723,221	2,968,019
R^2	0.946	0.406	0.427
Adjusted R^2	0.941	0.405	0.427

Standard errors (clustered by hotel) in parentheses. The data are aggregated for all hotel types. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 31: Two-month regressions Booking.com

	(1) Ext. use	(2) Int. use	(3) Price leader
March April 2016	1.35*** (0.20)	-0.57*** (0.19)	-0.05 (0.24)
May June 2016	16.80*** (0.53)	-0.16 (0.18)	-1.03*** (0.27)
July August 2016	16.73*** (0.57)	2.05*** (0.17)	2.50*** (0.37)
September October 2016	17.91*** (0.57)	1.65*** (0.21)	-0.81** (0.38)
November December 2016	15.50*** (0.63)	-1.61*** (0.49)	-0.24 (0.45)
January 2017	16.38*** (0.60)	3.72*** (0.26)	-2.39*** (0.43)
January 2017 × France	-6.84*** (0.76)	-5.71*** (0.37)	0.07 (0.69)
January 2017 × Italy	-4.13*** (0.77)	-6.81*** (0.50)	3.20*** (0.97)
January 2017 × Sweden	-14.94*** (0.72)	-1.69** (0.67)	-2.16 (1.40)
January 2017 × Austria	-11.91*** (1.45)	1.10 (0.89)	-6.09*** (1.46)
January 2017 × Canada	-16.88*** (0.71)	-1.16** (0.46)	-2.83*** (0.88)
January 2017 × Other countries	-16.02*** (0.64)	1.85*** (0.43)	4.32*** (1.62)
Avg. share of non-listed hotels	-0.02** (0.01)		
Avg. Kayak hotel rating	1.57*** (0.50)		
Avg. GT city	-0.01*** (0.00)		
Avg. GT Booking.com	0.03*** (0.01)		
Share of non-listed hotels		-0.27*** (0.00)	-0.03*** (0.01)
Kayak hotel rating		0.56 (0.46)	1.83** (0.82)
GT city		-0.05*** (0.00)	0.02*** (0.01)
GT Booking.com		0.02*** (0.00)	0.07*** (0.01)
Weekdays	No	Yes	Yes
Days before travel date	No	Yes	Yes
Other two-month-country interactions	Yes	Yes	Yes
Popularity other OTAs	Yes	Yes	Yes
Hotel FE	Yes	Yes	Yes
Observations	283,389	16,284,525	2,904,221
R^2	0.530	0.209	0.150
Adjusted R^2	0.478	0.208	0.149

Standard errors (clustered by hotel) in parentheses. The data are aggregated for all hotel types. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$